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ELECTRICITY IN TEXTILE MILLS.

The electrification of existing textile mills and the installation of electric drive in mills projected or under construction are topics of timely and vital interest in view of the enormous strides this country is taking in the cotton industry. With abundant supplies of raw cotton and comparatively cheap labor close at hand, not to mention the advantages of the enormous hydroelectric resources as yet undeveloped, there is no doubt that this country is bound to assume a leading place among nations of the world in the manufacture of cotton goods. The recent perfection of a machine for picking cotton will probably give added stimulus to the cotton planters and cheapen the raw material.

It is a fitting sign of the times that many of the large cotton mills in the South and New England states have already installed electric drive, even when this meant the scrapping of valuable steam machinery.

The development of power transmission in textile mills has been a logical development, as is pointed out in an article dealing with this subject which appears elsewhere in this issue. Successful installations of electrical equipment in many of our most prominent mills have done much towards convincing the most conservative that many conditions of manufacture are better met by the electric motor than by the steam engine.

Two essentials in textile manufacture may be mentioned as demonstrating the inherent advantages of electric drive over steam. The fluctuation of speed of the prime mover must be reduced to an absolute minimum, as very slight variations in speed will result in differences of tension of the yarn or thread sufficient to break it in its passage through the machines. The temperature of the various rooms must be kept at a definite constant level, as must also the humidity, in most cases.

Steam engines for textile manufacture are preferably of comparatively slow speed, and consequently are of massive build and expensive to operate, and must be equipped with enormous flywheels and installed with the best of care to reduce speed fluctuations and vibration. With individual drive, motor-driven machines may be kept at almost exactly constant speed, and by suitable provision for ventilation of the parts the temperature rise may be kept within well defined limits.

With the manufacturers realizing these and many other advantages of motor drive in their plants it is inevitable that electricity will soon be exclusively employed in textile mills. It follows, therefore, that the employment of electric motors, electric lamps, etc., in textile mills will open up a field for central-station service that is probably nowhere excelled, as few industries furnish as uniform a load and as high a load-factor on electrical supply systems. To secure these profitable loads, however, it is necessary to make very low rates for electrical energy, as many mills are situated in locations where fuel is cheap and the economy of natural gas and gas-producer plants has been proven. Some statistics relative to the cost of operating a gas-electric plant for furnishing energy for a textile mill were presented in our last issue.

ELECTRICITY ON THE FARM.

A careful perusal of statistics available, cannot fail to impress upon one the large percentage of the population of the United States who are farmers and the aggregate wealth they represent. These figures take on a new significance when it is realized that practically every farmer is a prospective purchaser of a residence electric lighting plant. The economic conditions of farm life have changed wonderfully during the last few years. The rural free delivery brings in the latest papers and magazines. Through these he learns of the latest achievements of science and the doings of the world. The telephone enables him to communicate with his neighbor or the city whenever and as often as he desires. The automobile provides a means of travelling rapidly on business or pleasure trips. These conveniences today the farmer cannot do without. So will it be with the electric lighting plants when their great conveniences and advantages are known.

Only a few years ago the isolated plant was considered a luxury that could only be enjoyed by the wealthy farmer. However, during the past five years, great improvements have been made in the individual component parts which make a successful lighting equipment with the result that the investment and cost of maintenance is moderate enough to be within the reach of all.

The dynamo, the storage battery and the low-voltage tungsten-filament lamp and the gasoline engine have all undergone such changes and improvements that they are now easily operated, economically maintained and furnish efficient, satisfactory service.

In a paper read before the National Gas and Gasoline Engine Trades Association by Mr. C. H. Roth, the author presents some very interesting and valuable figures on the cost of a residence lighting plant. When it is learned that a thirty-four light plant, complete, costs only $490 and the cost of maintenance per year including interest on the investment is only $71.65, electricity on the farm should receive a great boost.

Electric lighting for farm residences, while possessing many advantages over other systems, is insignificant when compared with the advantages of electric motors and electrically driven machines for the farm. In an article, dealing with this subject which appears on other pages of this issue, the wonderful progress being made by German farmers in installing electrically driven machines is described.

It seems that the success of the German farmers in utilizing electrical energy in practically every phase of farm work should stimulate central-station companies in this country to action in extending their lines to rural districts, thus making available a service which would be liberally used.

For those located out of the radius of prospective extensions of the lines of central stations, an isolated plant may be installed, at nominal cost, of sufficient capacity to furnish in addition to light, energy for operating the many machines within a reasonable radius of the plant.

In this connection attention may be called to the developments in distilling alcohol. Government experiments show that alcohol may be made from many farm products which are ordinarily destroyed, such as corn cobs, small potatoes, etc. The Department of Agriculture is sending out valuable literature explaining how alcohol stills may be constructed and operated. It is not looking too far ahead to realize community stills, where alcohol will be manufactured to be used as fuel for engines operating dynamos, thus cheapening the cost of isolated plants and widening the utility of electricity.

HUNTING.

In the early years of parallel operation of generators, many a station engineer and many a consulting engineer, too, has been driven almost to desperation by the refusal of the machines concerned to get in step and stay there. Not only was hunting hard to eliminate, but in many cases a sudden change of load would throw the two machines entirely out of synchronism. Overhauling of the governor mechanism and other obvious possibilities would be tried, but many cases proved obstinate, and even though operation was accomplished, there have been many cases in which hunting has never been eliminated.

The paper recently presented by Prof. Ernst J. Berg at a Chicago meeting on the subject of surging, and abstracted in our issue of December 3, contains the information which should render this question one of easy solution for any engineer who may have to face the problem. This subject is a good example of those problems which are hard to master by the cut-and-try method, but which succumb to an investigation from the theoretical side by the use of a little mathematics.

Professor Berg has shown the various causes for unstable equilibrium in parallel operation, and the remedies to be applied in each case.

STREET-LIGHTING AND POWER RATES.

In connection with a number of street-lighting cases recently heard before public regulating authorities it appears that the causes of the central-station companies would in some instances have been aided if the difference between street-lighting point out that the average return per kilo- clearly and authoritatively. Advocates of lower rates for street lighting point out that the average return per kilowatt-hour is higher from this source than from electric-motor service, and on the ground that the illumination of municipal thoroughfares and public places is characterized by long-hour demands upon the generating station and distributing system, it is contended that off-peak rates should be given to cities and towns depending upon local and public-utility organizations for such service.

There are a number of reasons why a company should be permitted to charge a higher kilowatt-hour rate for its street-lighting service than it enjoys from the sale of electricity to power users. It may as well be said at the outset that the rate per kilowatt-hour should not be the basis of municipal lighting charges, for the population of a municipality is fundamentally interested in the cost of light rather than in the cost of electrical energy. The whole tendency of modern progressive central stations upon renewing street-lighting contracts is to give the municipality more light per dollar expended than it formerly enjoyed. In innumerable cases this has been the experience, usually gained through the substitution of tungsten lamps for the old carbon incandescents, and thus giving the city or town from fifty to 100 per cent more light at each street unit than it formerly received, with little or no increase in the price per lamp per year. Where magnetite or flaming arcs have taken the place of alternating-current series street arcs the same result has in general followed, and if the operating company has gained something in efficiency by the use of new equipment of an advanced type, the municipality has always shared in the benefits of better and larger street illumination.

On the basis of unit costs of electrical energy, however, it is plain that some advance in the kilowatt-hour rate is justified in street illumination in comparison with power charges. In the first place, the lighting company is obliged to maintain a considerable equipment at the generating plant which is of no value for any except street-lighting service. If the system of street lighting is of the direct-current type, the company must either maintain arc machines or constant-current transforming equipment with rectifiers and attendant switchboard apparatus, all of which are idle during the daylight hours and absolutely useless for any other purpose. Further, the circuits by which the energy for street lighting is distributed over the company's territory can be used for nothing else, and this involves a large investment in pole-line or underground-conduit capacity which must stand entirely idle for approximately half the year. Even where alternating-current arc lamps or incandescents are employed for street illumination, the necessity of series operation to secure anything like distribution economy calls for the installation and maintenance of tub transformers and special switching facilities at the power house, and sets the line aside from other revenue production. The annual charges on all this equipment amount to something, and should properly include the value of space occupied in the station by rectifying or transforming machinery and switchboard apparatus, which are relatively bulky in proportion to the capacity involved.

On the operating side, it is to be noted that the question of maintenance is much more pressing in street lighting than in power installations. In the former, the company has to maintain service at hundreds of separate points less accessible than the premises of motor users, on the average. At each of these points is a mechanism requiring more or less adjustment for successful operation, regular trimming, occasional replacements of globes, cleaning, and constant inspection. Obviously there is no expense for meter reading at the point of consumption of energy, but there is the necessity of steady oversight in all weathers, which is without any parallel in the case of the power installation. At each of the power installations the initial adjustment of the motors and controlling and protective devices ordinarily suffices. At each point of power consumption the motor user absorbs perhaps twenty or thirty times as much energy as is taken from the lines by the municipality at each point of light utilization. Maintenance of electric-motor installations is very frequently handled by the owner of the motor equipment, and even where it is not, it is a comparatively small burden upon the central station as contrasted with the supervision required by the street-lighting equipment.

In a typical case, a city of 100,000 people is served by 844 arc lamps of the four-ampere magnetite type, furnishing a connected load of about 0.375 kilowatt per lamp. The power load is not far developed as yet, there being only 1,513 kilowatts connected motor load, or an average of 10.3 kilowatts per customer. The company sold last year 1,185,-430 kilowatt-hours for street lighting at an average return of 6.4 cents each, and 961,207 kilowatt-hours for power at a return averaging 3.8 cents each. The street-lighting service required an installation of 790,000 feet of wire, or practically one-half the distribution system of the company, which was useless for any other purpose. Under these conditions it does not seem that the margin between the lighting and power revenue per kilowatt-hour discloses any discrimination against the municipality. A thorough analysis of street-lighting investment would doubtless further strengthen the foregoing conclusions and indicate that this, like other forms of service, should be paid for upon some other basis than merely the amount of energy consumed. Fixed charges should always be considered.

TRANSPORTATION IN CHICAGO.

ADDRESS BEFORE CHICAGO ELECTRIC CLUB.

Some figures and interesting statistics pertaining to the work accomplished in the rehabilitation of the Chicago traction systems, were presented by L. H. Davidson, assistant secretary of the Board of Supervising Engineers, Chicago Traction, at the meeting of the Chicago Electric Club on Wednesday, December 14.

Some idea of the present status of the traction systems in Chicago was first given by Mr. Davidson, who said that the combined surface systems transport over 523,000 passengers daily. Comparing the present system with the old, Mr. Davidson pointed out that the public now gets a much longer ride for the same price than formerly; the cars are of the most modern type, insuring the most approved systems of heating, lighting and ventilation obtainable. The roadbeds are of the finest type of construction possible, which, in addition to providing more comfortable travel, make for increased speed of cars.

The capital account of the street railway companies in Chicago is at present about $111,000,000, which includes $55,000,000 valuation allowed by the valuation committee. Mr. Davidson said that there already has been expended for improvements, since the passage of the settlement ordinances in 1907, over $55,000,000.

Summarizing the work accomplished, Mr. Davidson said that over 765 miles of track have been rehabilitated, 2,000 double-track cars of the latest types have been added to the system, thirteen new substations, having an aggregate capacity of 100,000 kilowatts, have been constructed, and twenty-six car houses are now in use. There have also been constructed 415 miles of trolley, twelve miles of conduit, two hundred miles of duct and 3,000 manholes. Two tunnels have been completed under the Chicago River and the third, the LaSalle Street tunnel, is nearing completion. Work of removing some of the columns of the elevated railroad structure which prevent the new-type cars entering the tunnels will soon be completed, according to the speaker, and the tunnels ready for use by all cars.

In view of the vast expenditures made necessary by this rehabilitation work there is still left for the city its share of the earnings of the companies. The ordinance provided for fifty-five per cent of the earnings to go to the city and there is now available over $5,000,000.

The discussion was opened by S. F. Nichols, who said that Chicago probably had the best traction system of any city in the country. He spoke of the congestion during rush hours and said that these conditions obtain in every large city.

Mr. Rice said that the 415 miles of trolley reconstructed, as mentioned by Mr. Davidson, represented 7,500,000 pounds of copper.

T. Milton spoke of the Plymouth Street substation and described a storage-battery installation there which was installed to carry the morning and evening peak load of the station. The battery pulls 5,000 amperes per hour, and, according to the speaker, has saved the railway considerable money. The company pays the storage battery company a fixed amount per annum for maintenance.

The work being done on the LaSalle Street tunnel was briefly described by another speaker. The tunnel is 278 feet long and 48 feet wide and comprises a double-bore steel tube embedded in concrete. The tube was constructed at Goose Island and has been floated down the river to a point near the tunnel site, where it is now moored awaiting completion of details.

President Vose spoke of the traffic in Chicago and its relation to the traction systems. He referred to the trip of Captain Healy, of the Chicago police department, to Europe to study traffic conditions there and the results he was attaining in Chicago since that trip. Two years ago there were 485 arrests during the year for violation of traffic laws, while in 1910, to date, there have been only 41, this great difference being due to improved methods of handling the traffic.

Dinner and Medal Presentation to Edward Weston.

Dr. R. B. Owens, of Philadelphia, secretary of the Franklin Institute, gave a dinner at the Lotos Club, New York City, on Friday evening of last week, at which Dr. Edward Weston was the guest of honor. The occasion was the presentation to Doctor Weston of the Elliott Cresson Medal of the Franklin Institute, the award of which was announced in these columns two weeks ago. At the close of a very enjoyable dinner, Dr. Owens made the presentation in the following brief address:

"Dr. Weston, by virtue of the authority delegated to me, on behalf of the Franklin Institute of the State of Pennsylvania, I present to you the Institute's Elliott Cresson Medal and accompanying certificate in recognition of your brilliant and successful researches in the field of electrical discovery, and also in recognition of the indomitable energy you have so lavishly and so effectively expended throughout a period of nearly half a century in the advancement of the applications of electricity to fill the needs of and supply the wants of an ever increasingly complicated and exacting civilization.

"Speaking for myself, I think that you know, Dr. Weston, that I deeply appreciate the honor of being even the humble means of transmitting to you this award, and it is due to you to say, sir, that from no one have I drawn greater inspiration in the past, and certainly no one has lent me such assistance as you have in my efforts to educate to a sound understanding of the principles of science and their application in engineering, scores of young men in this country and in one of England's greatest colonies."

Dr. Weston in response, after expressing his thanks and deep appreciation, reviewed at some length, and most interestingly, the electrical work in which he had participated from 1871 until the present time. His remarks were very instructive, and charmed the gentlemen in attendance. Many of the guests spoke in terms of appreciation of Doctor Weston and the great work he had done in the electrical and chemical fields. Among the speakers were Gano S. Dunn, Dr. Alexander C. Humphreys, John J. Carty, William Stanley, W. C. L. Eglin, Ralph W. Pope and Col. Samuel Reber.

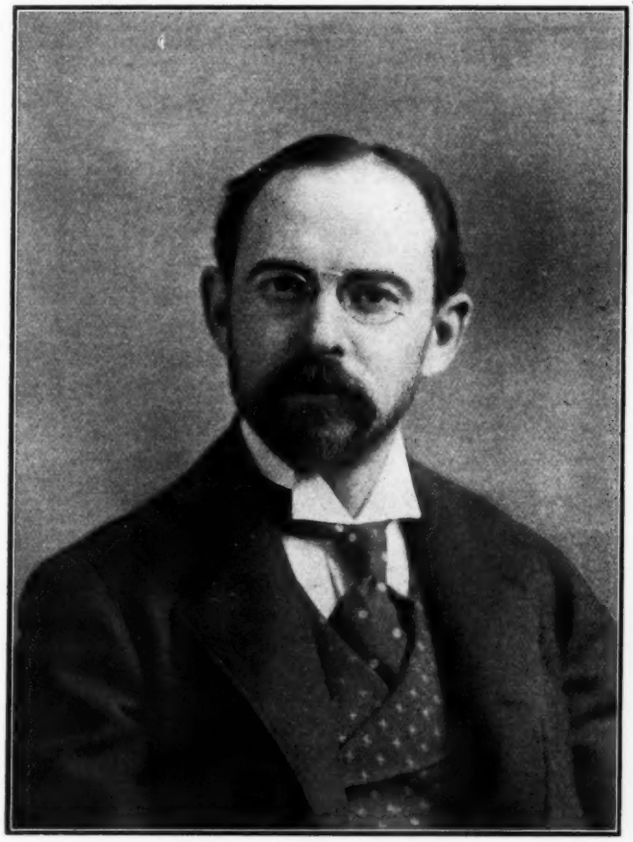
The invited guests were the following: Louis Duncan, F. B. Crocker, C. F. Chandler, C. F. Brackett, Gano S. Dunn, L. A. Osborn, Charles P. Steinmetz, William Stanley, John J. Carty, Charles W. Price, W. D. Weaver, Samuel Insull, S. W. Stratton, Samuel Reber, D. C. Jackson, Ralph W. Pope, W. C. L. Eglin, Alexander C. Humphreys.

E. W. Rice, Jr.

As the year draws to a close one begins to sum up the accomplishments of the twelvemonth and in the electrical industry we naturally direct our attention toward those who figure prominently in the affairs of the great institutions which contribute to the development in this field. Conspicuous among the strong men who have shaped the destinies of one of these large organizations is the subject of this sketch, Edwin Wilbur Rice, Jr.

Mr. Rice is not only an engineer—he is a business man, a constructive genius, and an executive of demonstrated ability. Mr. Rice was born at La Crosse, Wis., May 6, 1862, and was graduated from the Philadelphia High School at the age of eighteen. Under the guidance of his instructor, Professor Elihu Thomson, he showed exceptional ability in the design and construction of special apparatus during his last two years of school work, and he became an assistant to Professor Thomson. Upon graduation he determined to give up his collegiate course and took up electrical work with his old teacher, first in Philadelphia, where the early arc-light dynamos were built, and later at New Britain Conn., where the works of the newly formed American Electrical Company were established. Not very long after this the business was acquired by other interests and transferred to Lynn, Mass., under the name of the Thomson-Houston Electric Company. In this connection Mr. Rice had great opportunity for the work which was most acceptable to him, and in conjunction with Professor Thomson worked out many of the details of the historical apparatus which was at that time and has since been given to the world. His grasp of the details of the business, together with his engineering instinct, were recognized by those in authority at the Lynn works, and when still in his twenties Mr. Rice became superintendent of the plant.

When the Edison and Thomson-Houston Companies were united to form the present General Electric Company, Mr. Rice became prominently identified with the new corporation. In the larger interests of this organization the understanding of the essentials, and the directive ability which had hitherto marked his work, were given greater scope, and in 1893 Mr. Rice was appointed chief engineer of that concern, and with this came the opportunity to assist in the molding of this organization into its present high place in the industrial world. Three years later, in addition to his duties as technical director, he was made third vice-president of the General Electric Company, in that capacity harmonizing the technical and commercial interests of the business. Combined with the characteristics which have been mentioned, Mr. Rice has a fine intuitive understanding of men, and this generalship has enabled him to gather about him a most efficient corps of engineers.



E. WILBUR RICE, JR.,
Vice-President of the General Electric Company.

Mr. Rice has been associated with railway and lighting developments since their beginnings. He was the first to advocate a flexible motor suspension in electric cars, and more than one hundred patents have been granted him in this country. His talent and knowledge in the development of high-voltage stations and transmission systems, and in devising methods for handling and controlling high-tension currents have been marked.

He is a valued member of many engineering and scientific organizations, including the American Institute of Electrical Engineers, the American Association for the Advancement of Science, the Institution of Civil Engineers, and the Institution of Electrical Engineers of Great Britain. At the Paris Exposition of 1900 he was created a Chevalier of the Legion of Honor, and in 1903 Harvard University conferred upon him the honorary degree of Master of Arts. In 1906 Union University, of Schenectady, N. Y., conferred upon him the degree of Doctor of Science.

Mr. Rice is a member of the Engineers' Club of New York, the University Club of Boston and the Pilgrims Club.

New York Electrical Society.

At the meeting of the New York Electrical Society on December 14 an address was made by Charles N. Chadwick, Commissioner of the Board of Water Supply of New York, on "The Catskill Water Supply."

An amendment to the constitution was passed creating a life membership in the Society. The following life members were elected: Frank J. Sprague, Arthur Williams, R. T. Lozier, H. Ward Leonard, T. C. Martin, Kingsley G. Martin, C. A. Coffin, C. G. Young, Harry Alexander, John J. Carty, John W. Lieb Jr., W. S. Barstow, Charles Blizard, H. H. Barnes Jr., Cyrus O. Baker, Gano Dunn, C. O. Mailloux, Robert Lundell, A. M. Young, L. B. Nutting, L. K. Comstock, Thomas A. Edison, F. C. Bates, I. L. Meloon, H. Taylor Cronk.

The Indiana Engineering Society will hold its annual meeting at Indianapolis on January 12, 13 and 14.

Eastern New York Section, National Electric Light Association.

The first meeting of the season of the recently formed Eastern New York Section of the National Electric Light Association was held at Schenectady on December 13. A large gathering of men from the cities and towns of Eastern New York was present to welcome President W. W. Freeman and Secretary T. C. Martin of the National body, the principal speakers of the evening.

Bryce E. Morrow, of the Hudson River Electric Power Company, presided at the meeting, the address of welcome being given by Mayor Duryee, of Schenectady. Mr. Feeman was then introduced and his account of the growth of the National Association and its field of usefulness was very enlightening. The benefits of the Association were very conclusively stated by the speaker, and he accounted for the rapid advancement of the Association to its position of today on the score of its great utility to the electrical industry.

National Secretary T. C. Martin elaborated some of the points brought out in President Freeman's speech, and especially interested the many young men present by picturing the splendid opportunities offered in both central-station work and in the manufacturing industry.

M. Webb Offutt, manager of the Schenectady Illuminating Company, showed clearly the value of a local organization of men interested in the commercial phase of the electrical industry in bringing together the central station, contractor and general public.

C. D. Haskins, manager of the Lighting Department, General Electric Company, was very optimistic about the future of the local organization. He predicted for Schenectady, with its large body of men interested in things electrical, a large engineering building with headquarters for a number of scientific organizations.

Commercial Motor Car Show for Chicago.

A comprehensive display of motor trucks, delivery wagons and self-propelled road machines for all sorts of industrial purposes is to be held in Chicago during the week of February 6 to 11 next. It will follow immediately after the annual automobile show, will also be held in the Coliseum and be conducted by the same management, under the auspices of the National Association of Automobile Manufacturers.

It is estimated that upwards of 200 different models of work vehicles will be displayed, representing a value of more than half a million dollars. In addition the gallery and second floor of the Annex will be filled with 150 industrial displays of parts, fittings and supplies pertaining to the motor car.

Power vehicles suitable for almost every kind of industrial and commercial business will be shown, from trucar parcel carriers for the quick delivery service of laundries, haberdashers, boot and shoe stores, confectioners and other retailers of light goods, to ponderous motor trucks of five tons load capacity or more.

World's International Trade in 1910 Establishes New High Record.

The world's international trade promises to make a new "high" record in the calendar year 1910. Figures received by the Bureau of Statistics, Department of Commerce and Labor, show that in nearly every country of the world both imports and exports are larger than in 1909, and the reports thus far received indicate that the grand total of the world's international commerce in 1910 will reach a higher figure than ever before.

The Cleveland Electrical Code.

The electrical code recently adopted by the city of Cleveland, O., provides that all electrical conductors with the exception of trolley lines on the main city streets be placed in underground conduits, and also provides for the proper supervision of all electrical work.

This code places all electrical construction, interior wiring, street lines for signal, fire alarm, power and other purposes under the control of the building department. This division of the department will be in charge of an electrical engineer, with the title of City Electrician, at a salary of $2,000 per annum, and will comprise a Chief Inspector of Electricity at $1,500 per annum, a permit clerk at $1,000, and six inspectors of electrical wiring and appliances. The qualifications of these officials are prescribed and they will be required to furnish a surety bond.

New Ritz-Carlton Hotel Opens in New York.

The new Ritz-Carlton Hotel, of New York, N. Y., which was recently opened to the public, is conceded as among the best, both from the standpoint of appearance, interior and exterior, and many conveniences offered its patrons.

The most perfected stage of engineering practice is evidenced in many of the conveniences, such as elevators, heating and ventilating, ice plant, pneumatic tubes, etc., and as has come to be common practice, electricity plays an important part in the operation of these systems.

Of particular interest is the lighting installation in this hotel which, it is said, is carried out on a scale equally as elaborate as the interior decorations. At an opening dinner, which was tendered the press, the elaborations of the illumination and decorations of the main restaurant was particularly impressive. An ingenious arrangement of electric lights is employed in this room, wherein all lighting units are totally concealed from view.

Membership of National Electric Light Association.

The National Electric Light Association reports that it is continuing to enjoy the growth which it has experienced so remarkably during the past eighteen months. On December 12 the membership reached the high mark of 6,007, inclusive of 904 operating companies and 222 manufacturing concerns. The operating companies and their sections have 4,133 employees and members of their staff in Class B membership. The membership in July, 1909, was 3,137 and at the meeting of the Executive Committee last January was reported as 4,500, so that the net growth during the present year, after dropping 250 individual members for various reasons, is around 1,500. H. H. Scott, the energetic chairman of the membership committee, has, with the aid of this large, enthusiastic committee, just set on foot another membership campaign and there seems every reason to believe that 1911 will witness a growth in every way equal to that just noted.

The Christmas week meeting of the Toronto Company Section, National Electric Light Association, will be devoted to entertainment features. It will be held on December 29.

Electricity in Stove Manufacture.

Description of the Electrical Installation in the Cribben & Sexton Plant.

The new plant of the Cribben & Sexton Company, manufacturers of Universal stoves and ranges, occupies a space approximately 1,000 feet by 357 feet between West Ohio Street and the Chicago, Milwaukee & St. Paul tracks, extending from Franklin Boulevard to Albany Avenue. This Company, which has occupied a row of buildings at Erie and Townsend streets, has erected this new factory in order to get more space and better shipping facilities.

The buildings which have been erected include a foundry 325 feet by 240 feet, a cleaning room 32 feet by 152 feet with a pattern shop above, a warehouse and assembling building 480 feet by 100 feet, a power house 50 feet by 100 feet, and an enameling building 100 feet square.

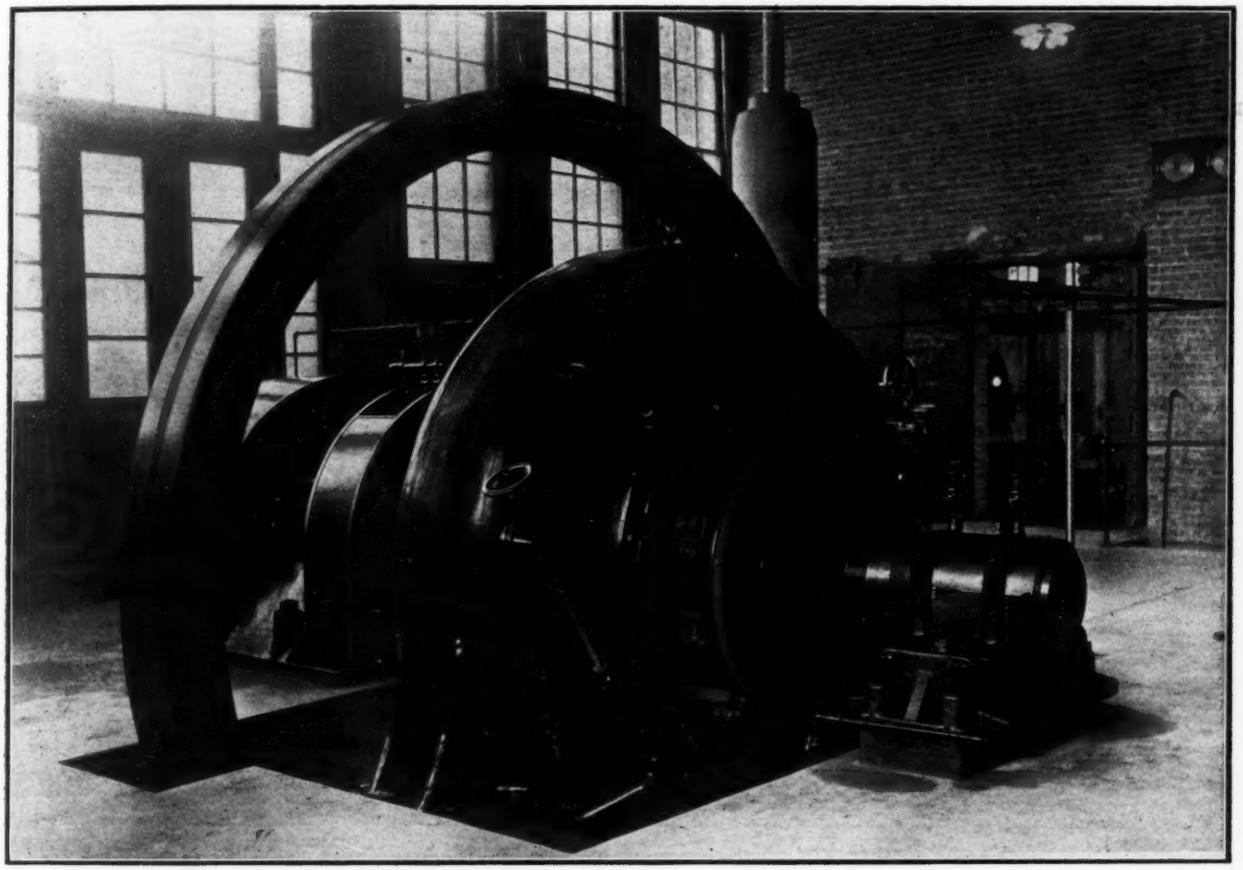
The power house, enameling building and foundry are one story high with saw-tooth roof construction. The warehouse is four stories in height. All buildings are of brick with mill construction floors.

The plant is furnished with electrical energy for lighting and all power purposes, heat and live steam, from an isolated plant, which, as mentioned above, is located adjacent to the enameling building and along a spur track of the St. Paul railroad, so that coal may be conveniently received.

The boiler room occupies about one-half of the plant and is separated from the engine room by a brick firewall. The boiler-room installation comprises two Stirling water-tube boilers, each of 300-horsepower capacity, located in a row. The boilers are connected to a brick stack 66 feet by 150 feet high by means of a sheet-steel smoke flue. The stack was built by the Heine Chimney Construction Company. The breeching and stack are of sufficient capacity to take care of a third boiler should it ever be required and at present serve to remove the gases from the enameling ovens.

The boilers are equipped with Green chain grate stokers, operated by a standard steam engine. The ashes are discharged from the stokers into brick-lined steel hoppers which are located in a tunnel below the boiler-room floor. In this tunnel is a truck carrying a trunion car body which can be removed from the truck by means of a hand crane just outside of the power house building and set on a side dump truck which runs on the tracks of the industrial railway extending to all parts of the plant.

The plant is equipped with an open feed-water heater of the Webster type and with two duplex steam-driven boiler-feed pumps, one 7 by 4 by 10 and



GENERAL VIEW OF POWER PLANT, CRIBBEN & SEXTON COMPANY, CHICAGO.

one 7 by 4½ by 10, built by the Platt Iron Works. These pumps are installed in the boiler room north of the row of boilers. The piping was done by Kroeschell Brothers and the pipe covering supplied by Ehret Magnesia Manufacturing Company. The power plant is equipped with a central oiling system. There is a small basement under a portion of the engine-room floor immediately beside the main engine. This basement contains the exhaust piping, valves, etc., and a Burt filter. The drip lines from the various bearings discharge into this filter and after passing through it are taken by a small steam pump in the engine room to an oil tank located in the high portion of the boiler room which feeds the various oil cups by gravity. The steam piping throughout the plant is relatively small.

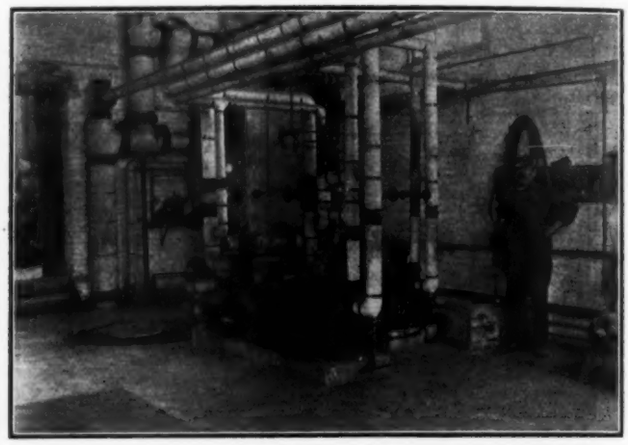
From the power plant to the warehouse and to the enameling building there is a system of piping supplying steam and hot water to these buildings. This piping is run underground in a concrete duct with a removable reinforced concrete top. The electric cables are carried in parallel ducts and are lead sheathed.

The engine room contains a Nordberg engine 20 by 42 inches of the double-eccentric long-range cut-off type direct connected to a Crocker-Wheeler generator of 250 kilowatts capacity running at 110 revolutions per minute. Space has been provided for a second machine. The generator is connected to a red Tennessee marble five-panel switchboard equipped with Weston flush-type station instruments, "I. T. E." circuit-breakers and Thomson wattmeters. From the switchboard two large mains supply the foundry and the warehouse building respectively, while small mains supply the enameling department and power plant.

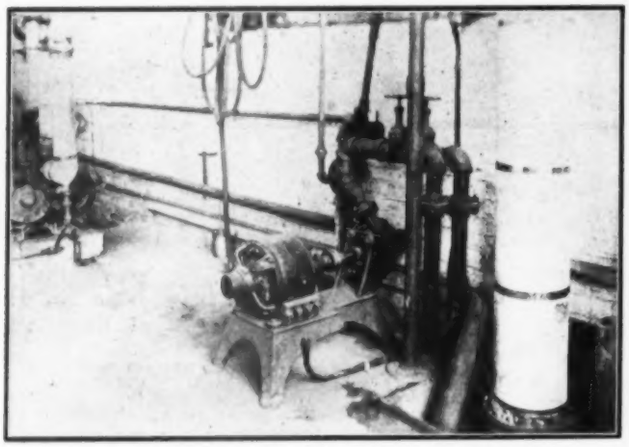
The power equipment of the foundry consists at present of one Piqua cupola blower geared to a variable-speed motor, a cinder mill belted to a motor and an elevator of the Otis type. The steel work for a second charging platform is in place and within the next sixty days the present foundry equipment is to be duplicated. All pouring in this foundry is done by hand and no cranes are used. This method is employed on account of the extremely thin castings produced by this foundry which necessitates hot metal and rapid pouring.

The north end of this fountry is lighted by means of mercury-vapor lamps. The south end is equipped with flaming-arc lamps. A number of both types of lamps were in service in the old plant of the same company and the present arrangement is to give definite information as to which system is best adapted to this class of work. The cleaning room is equipped with two batteries each of ten tumblers. Each battery is driven by a motor mounted on a bracket and each tumbler is connected with a shaft by means of a friction clutch. The cleaning room also con-

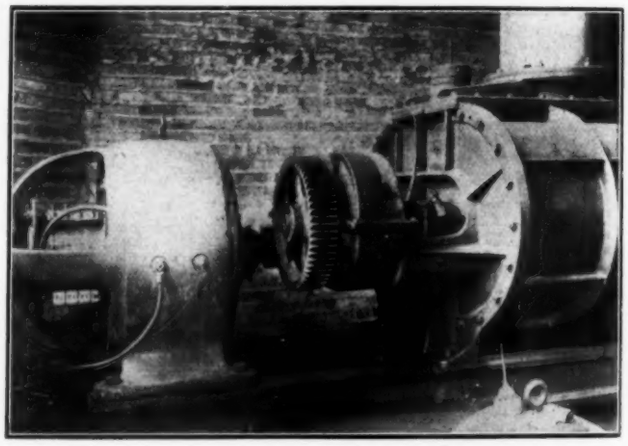
SWITCHBOARD—CRIBBEN & SEXTON PLANT.



BOILER-FEED PUMPS.



MOTOR DRIVING HOT-WATER PUMP.



MOTOR DRIVING FOUNDRY BLOWER.

tains grinders. The cleaning room is equipped with a dust collector system furnished by the Cyclone Blow Pipe Company having a direct-connected fan and motor mounted near the ceiling.

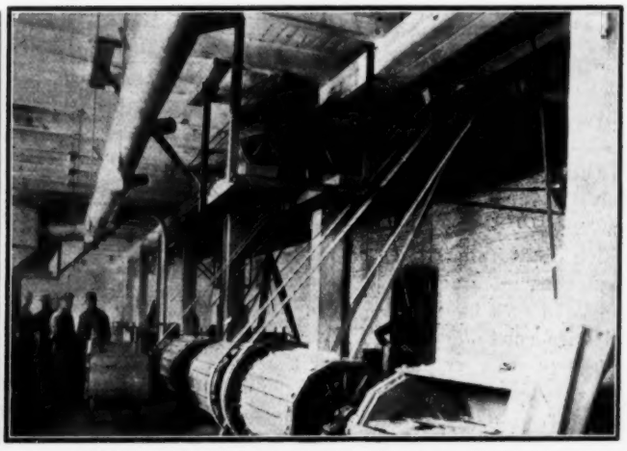
On the floor above the cleaning room double-wheel stands driven in two groups from thirty-five-horsepower motors mounted on platform suspended from the ceiling. Each double wheel grinder or buffer is operated by means of a friction clutch. This room is provided with two independent dust-collecting systems with direct-connected motors and fans discharging into a common Cyclone collector.

The plating department contains three Hansen & Van Winkle plating generators direct connected to motors. The other manufacturing departments on the lower two floors of the warehouse building have all machines motor driven by means of group drives. Motors in general are suspended from the ceiling.

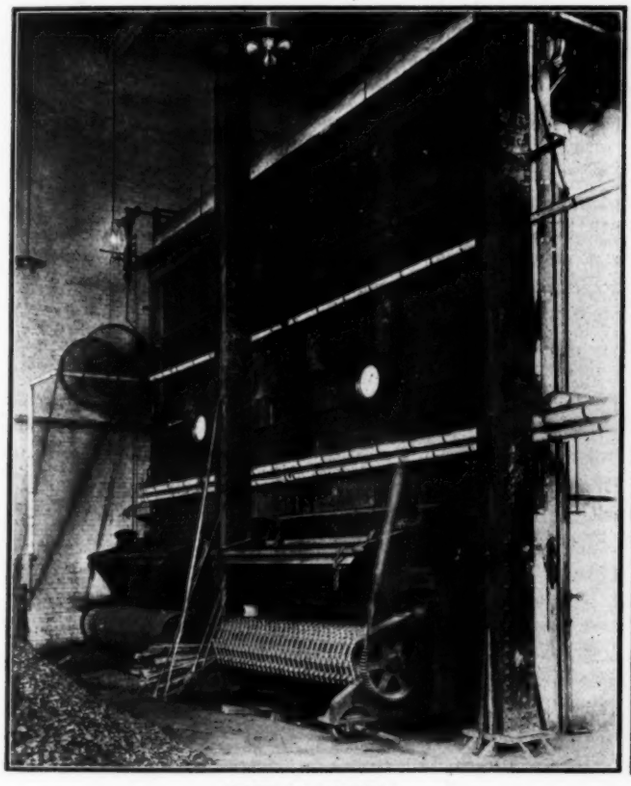
The manufacturing portions of the plant are lighted mainly by means of Coopper-Hewitt mercury vapor lamps and with clusters of incandescents. The warehouse portions of the building employs single incandescent lamps. No arc lamps are used outside of the foundry.

The wiring installation of this plant

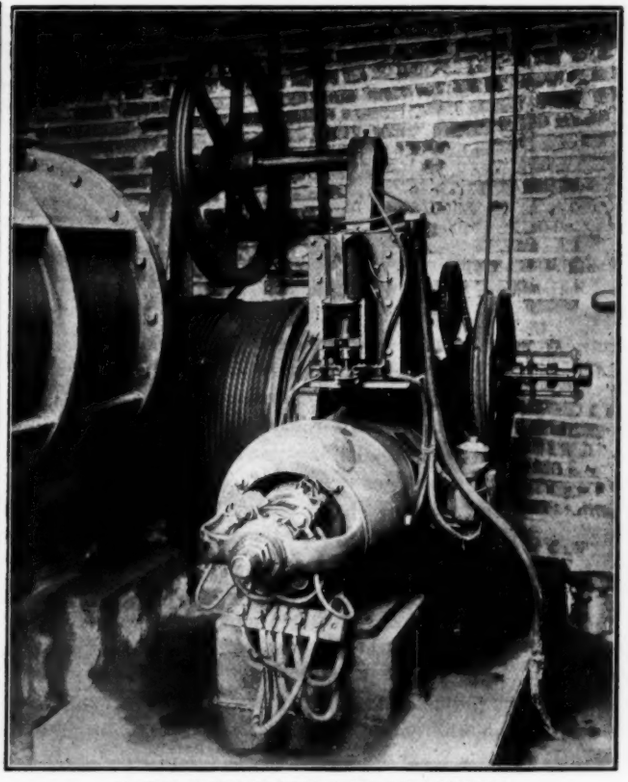
MOTOR DRIVING BLOWER IN FOUNDRY.



MOTOR DRIVING GROUP OF CASTING TUMBLERS.



VIEW OF BOILERS.



MOTOR DRIVING ELEVATOR MECHANISM.

the pattern shop for wood and for metal patterns have machines, group driven by motors.

An underground tunnel connects the cleaning room with the polishing and nickel departments in the warehouse building. The polishing room contains

was made by Henry Newgard & Company. The motors and generator were supplied by Crocker-Wheeler Company. W. L. Fergus & Company were the consulting electrical and mechanical engineers.

The Electric Stress at Which Ionization Begins in Air.

A paper with this title was read by A. Russell at a recent meeting of the Physical Society of London.

In the *Proceedings* of the American Institute of Electrical Engineers for July, 1910, J. B. Whitehead publishes the values of the electric stress at which ionization begins in air. The electrodes he used in his experiments consisted of a metal tube and cylindrical wire coaxial with it. Alternating pressures were employed, and the inner wires used had diameters varying in size from 0.089 to 0.475 centimeters. If a be the radius of the inner wire, the author has found that the expression $32 + 13.4/\sqrt{a}$ gives all Whitehead's experimental results for the maximum electric stress in kilovolts per centimeter with a maximum inaccuracy of less than one per cent. The experiments show that the electric stress at which ionization occurs is independent of the metals used for the electrodes and of the inner radius of the outer tube. It depends merely on the radius of the inner wire. It is shown that Steinmetz's experimental results on the sparking distances between parallel rods are in substantial agreement with Whitehead's figures. Possible reasons for the discrepancies are given. An empirical formula is given which is based on experimental results recently published by Kowalski and Rappel for the sparking voltages between equal spherical electrodes. The results indicate that the electric stress at the moment of discharge has a minimum value when the distance between the electrodes is a certain function of their radius. The author lays great stress on the currents of electrified air which stream round the electrodes before the discharge takes place and the effects of which it is customary to neglect. These currents often modify very appreciably the values obtained for the disruptive stress at the moment of discharge. The striking similarity between the formulas for the temperature-gradient at the surface of a hot wire cooling in air and the empirical formula for the potential gradient at the surface of an electrified wire when ionization is taking place at its surface is pointed out.

In the discussion C. Chree remarked that when the electrodes were close together electrostatic attraction might produce an actual transfer of matter from one electrode to the other. The effect of the electrostatic attraction on the diminution of the distance between the electrodes would depend upon the nature of the apparatus used.

Railroad Company Asks for Suggestions.

In order to collect material which may result in placing the operation of its line on a higher plane, the officials of the Terre Haute, Indianapolis & Eastern Traction Company have issued cards to its employees asking for suggestions concerning better operating service. The company's employees are asked to give their ideas on ways for securing better conditions as to safe operation and their opinions as to speed, stops, schedules, etc.

Mercury Vapor Water Sterilizer.

A description of a water sterilizer making use of a mercury vapor lamp appeared in a recent number of *The Electrical Times*. With this apparatus in which light from a mercury-vapor lamp shines through quartz partitions into the circulating water, tests showed that in many cases the water after treatment was absolutely sterile. In no case did the test show more than ten germs per cubic centimeter.

Earth Currents During Comet's Transit.

During the transit of Halley's comet, observations of earth currents were made at Stockholm, Sweden, by D. Stenquist and E. Petri, and are given in the last number of *Tenestual Magnetism and Atmospheric Electricity*. The resistance of the earth between two points was previously measured, and readings taken from minute to minute of the difference of potential. The measured currents were considerably above the normal for the time of day (midnight to 3:45 a. m.) but not so large as during a magnetic storm.

Proposed Electrical Exhibition.

Cape Town is to have an electrical exhibition in March, 1911.

Justice Le Boeuf on Obsolescence.

A new principle in connection with the valuation of special franchises was given by Justice Le Boeuf in connection with the case of Brooklyn Rapid Transit Company which recently came up for trial. The Rapid Transit Company held that its franchise tax valuation should be reduced from $1,365,842 to $334,538. This contention was upheld by Justice Le Boeuf, who said there should be a charge off for obsolescence. His remarks, in part, follow:

"If the State Tax Commission's decision is to be construed as laying down the rule that no allowance shall be made for obsolescence or inadequacy of equipment not yet sustained, but capable of reasonable ascertainment for the future, it does not appear to me to be consistent with the expressed policy of this State. As surely as humanity travels from the cradle to the grave, the machinery and equipment of a public service corporation travel toward the scrap pile. The plant and structures depreciate in less degree, but as certainly. This is ordinary depreciation.

"But another form of depreciation in the case of properties here being valued takes place. The machinery or equipment, while still capable of years of service, becomes inadequate to do the work demanded, not only by the corporation, but by the law itself. In the case particularly of electrical machinery the type becomes obsolete by reason of invention, and increasing public demands frequently require in aid of safe and adequate service, that the obsolete appliance or equipment give way to renewal. Some of these changes are capable of definite ascertainment. Many of them may be provided against for the future by setting aside from gross earnings a reasonable sum to create a reserve against the day when they shall come. This reserve, with the amounts set apart for ordinary depreciation, go to amortize the capital of the company. Amortization of capital is something of a novelty in the case of public service corporations. Amortization of securities of trustees and money corporations has been known for many years and the principle has been applied by manufacturing corporations. Public service corporations alone were slow to recognize this necessity.

"The wrecks of many such corporations scattered throughout the state would not today be seen if early this principle had been applied to their accounting.

"In the old days after original paid-in capital and original bond issues had regularly paid their dividends and interest out of earnings, and the plant had depreciated or become in whole or in part inadequate or obsolete, it was necessary to issue a new batch of bonds to cover a new plant, while the old plant was actually on the books at practically its original value. Capital remained apparently unimpaired and clamoring for dividends. If the money were actually obtained, the bond holders sooner or later owned the road and upon reorganization were obliged in the interest of the property to eliminate in whole or in part the original stock holders.

"The Public Service Commission law recognizes this amortization principle and yet the state tax commission is insistent that no reasonable basis exists for the creation of an amortization fund.

"If a public service corporation comes into court and requests that it be permitted to set aside a reasonable amount of its gross earnings for such an amortization fund, it is difficult to understand why the court should refuse to consider that request."

National Gas and Gasoline Engine Trades Association.

The fifth meeting of the National Gas and Gasoline Engine Trades Association, which was held at Racine, Wis., December 12 to 15, was well attended and was in many ways the most successful convention in the history of the Association. About 300 members were present and papers were read which concerned not only those directly interested in the gasoline-engine industry, but those concerned with the allied machinery trades and electrical supply business as well.

The purpose of the Association, which was formed only two years ago, has, as may be seen from the title, the object of bringing about more intimate relations between manufacturers and dealers, and in this and other ways, bettering the gasoline-engine industry.

The first day was taken up almost entirely with the arrangement of exhibits and the registration of the arriving members. Those manufacturers presenting exhibits at the convention were as follows: The Knoblock-Heideman Manufacturing Company, South Bend, Ind.; R. D. Loose Manufacturing Company, Chicago; The Lunkenheimer Company, Cincinnati; The Phansteihl Electrical Laboratory, Chicago; The Parker Manufacturing Company, Lansing, Mich.; Wheeler & Sehebler, Indianapolis, Ind.; The Dayton Engineering Laboratories Company, Dayton, O.; Great Western Smelting & Refining Company, Chicago; Hercules Electric Company, Indianapolis, Ind.; The Bosch Magneto Company, New York, N. Y.; Freeman & Sons Manufacturing Company, Racine, Wis.; Mound City Paint & Color Company, St. Louis, Mo.; Rock Island Battery Company, Cincinnati, O.; Roth Brothers & Company, Chicago; Motsinger Device Manufacturing Company, Pendleton, Ind.; Lutz-Lockwood Manufacturing Company, Aldene, N. J.; K. T. Jacobsen & Company, Racine, Wis.; The Electric Storage Battery Company, Chicago; Witherbee Igniter Company, Springfield, Mass.; Peoria Governor Company, Peoria, Ill.; Standard Foundry Company, Racine, Wis.; Nungesser Electric Battery, Cleveland, O.; Acheson Oildag Company, Port Huron, Mich.

The second day of the convention was taken up by the address of welcome by Mayor Horlick, the response by M. A. Loeb, president, and the reading of various reports. A number of papers were read in the afternoon, which were as follows: "The Gasoline Engine of Tomorrow," R. C. Bristol; "Gasoline Engines on the Farm," J. G. Finkbeiner; "The Relation of the Manufacturer to the Farmer," C. O. Ocock; "Kerosene as a Fuel," George M. Holley; "The Gasoline Engine in the Agricultural Field at Home and Abroad," George A. Cormack, Jr.; and "Practical Electricity on the Farm," C. H. Roth. An abstract of Mr. Roth's paper follows:

ELECTRICITY ON THE FARM.

This paper reviews the development of the various parts that go to make up an isolated lighting plant, considering in turn the gasoline engine, the dynamo, the storage battery, the lamps, switchboard and accessories. The author then itemizes the cost and maintenance of a typical plant, for illustration considering a thirty-four light installation. The location of these lamps are mentioned and it is assumed that the plant is in use fifty-seven lamp hours. Calculating on this basis the author figures the cost of apparatus of sufficient size to be as follows: Storage battery, $115; dynamo, $43; gasoline engine, $80; switchboard and instruments, $70; lamps, $22; wire, insulators, fuses, etc., $55; fixtures, globes, etc., $50, and cost of wiring, $55, making the total cost $490. The cost of operation and maintenance per year is summed up as follows: Fuel $18.25; maintenance of storage battery, $10; maintenance of engine and dynamo, $8; cost of lamp renewals, $6; interest on the investment at 6 per cent. $29.40, the total being $71.65. This divided by 365 days equals 19.6 cents per day and this divided by the number of lamps used gives a cost of a little more than one-half cent per lamp per day. The paper then points out how a slight additional expenditure will allow the installation of a number of motors to operate such machines as separators, washing machine and water pump. The author points out the numerous advantages of motor drive and gives a rather complete list of farm machines which are particularly suited to be driven by electric motors. Among the most prominent advantages of installing an electric plant on the farm, as pointed out by the author, may be mentioned the elimination of matches and lanterns, lessening fire risk; current for lights or motors may be transmitted to any point around the farm by wires; the conveniences of switching on or off the current from a distant point, etc.

Papers read on the second day were: "Gas Engines, Frederick Lammert; "The Installation of a Mechanical Ignition System," H. F. Apple; "Does the Efficiency of a Gas Engine Depend on Its Equipment?" Charles Kratsch; "Gas Engine Accessories," Otto M. Knoblock; "Simplicity the Basis of Reliability," J. C. Miller.

The morning session closed with a demonstration of the action of spark coils, which was given by Carl Pfansteihl.

At the afternoon meeting, the papers read were as follows: "Comparison of Various Methods of Testing Engines," Joe Tracey; "Side Lights on Gas Engine Electric Lighting," W. H. Coles; "Gas," H. I. Lea; "The Relation of Ignition to Engine Efficiency," Roger Whitman; and "Gas Producers," H. F. Smith.

The papers presented before the third day's meeting were confined entirely to the subjects of sales and advertising. Titles of these papers follow: "The Salesman's Angle," C. O. Hamilton; "Salesmanship vs. Manhood," J. E. Hozier; "Scientific Salesmanship," Wm. T. Goffe; "Advertising to Help the Dealer," H. E. Beveridge; "Cost and Cost Systems," F. W. Guthrie; "General Talk on Advertising," F. E. Long; "Mail Order Gas Engines," S. M. Walker.

Officers elected were as follows: President, C. O. Hamilton, Elyria, O.; vice-president, O. C. Parker, Racine, Wis.; treasurer, A. M. Knoblock, South Bend, Ind.; secretary, Albert Stritmatter, Cincinnati, O.

The informal reception and smoker which was given by the Racine Club on Tuesday night and the banquet at the Hotel Racine on the following day were decidedly successful and furnished means for more intimate acquaintance on the part of the members present.

Electrification of Terminals in Chicago.

The question of the electrification of the terminals of Chicago steam roads was again taken up at the December 19 meeting of the Chicago City Council. A parallel movement was made by the Chicago Association of Commerce, which asked the Mayor to appoint a committee to confer with the Association's commitee on this subject. The latter committee is said to be composed of prominent engineers who have studied the problem of electrification fully and found it entirely feasible.

The action of the City Council was in the shape of an ordinance demanding that all steam roads proceed immediately to electrify their lines within seven miles of the City Hall. It fixed the final date as January 1, 1913. The ordinance was referred to the local transportation committee. An ordinance was proposed at a Council meeting about a year ago, but the committee to which it was referred has, as yet, made no report.

The Magnetic Properties of Iron and Its Alloys in Intense Fields.

At the meeting of the Institution of Electrical Engineers in London on December 8, a paper with the above title was presented by Sir Robert A. Hadfield and Prof. B. Hopkinson. An abstract of the paper follows:

The magnetic properties of materials in fields of very high flux-density are of great scientific interest on account of their bearing upon the molecular theory. According to this theory an intense field completely swamps the effects of the mutual interactions of the magnetic molecules which are responsible for the complicated relations in weaker fields. In the expression

$$B = H + 4\pi I$$

where B represents the flux-density and H the intensity of the magnetizing field, I is the sum of the magnetic moments of the molecular magnets contained in a unit of volume. I may vary with the temperature and other physical conditions, but it is to be regarded as a constant with respect to varying magnetic conditions, and the value $4\pi I$ is the saturation value. This must be regarded as a fundamental magnetic constant. Its value has been determined for approximately pure iron and for alloys of iron with carbon, silicon, aluminum and nickel respectively. The isthmus method was used and the magnetic flux measured by the use of a ballistic galvanometer. The values of I may be regarded as constant in these alloys. The specimens were in the form of tiny cylinders, five millimeters in diameter and filling the airgap between the pole pieces, amounting to one-quarter inch, and field-strengths up to 25,000 units could be obtained. The following are the most important results obtained: (1) Every alloy examined, without exception, has a definite saturation intensity of magnetization. In most cases this is reached in a field of 5,000 units, but in a few there is a small increase between 5,000 and 25,000. The forms of the curves of magnetization concerning I and H in these exceptional materials, however, leave no doubt of the existence in them also of a saturation value of I. Every one of the materials tested, without exception, behaves as though it consisted of a mixture of magnetic substances with non-magnetic substances having a permeability not differing materially from unity. This holds good also for the non-magnetic or nearly non-magnetic nickel or manganese alloys, and, in this respect, the results differ from those obtained by Ewing and Low—according to whose experiments a nearly non-magnetic manganese-steel had a constant permeability of about 1.4. Among all the alloys which we have tested there is none having a constant permeability differing from unity by more than two per cent. (2) There is in the series no alloy having a higher specific magnetism than pure iron. (3) The saturation value of I for pure iron of density 7.80 in absolute units is 1,675 within one per cent. This is slightly lower than the values obtained by Ewing and Low and other experimenters. (4) In an annealed iron-carbon steel in which other elements are present in small proportions, the specific magnetism is less than that of pure iron by a percentage equal to six times the percentage of carbon. This result constitutes a verification, in the case of annealed iron-carbon alloys of the linear relation connecting the magnetism of a mixture with the magnetisms of its constituents. In this case there are two constituents, mechanically mixed, viz., pure iron and iron-carbide, the percentage of iron carbide being 15.5 times that of the carbon in the steel. It is readily deduced that the magnetism of carbide of iron is about two-thirds of that of pure iron. (5) Quenching an iron-carbon alloy from a high temperature reduces the specific magnetism by a large but somewhat uncertain amount. (6) The addition of silicon or aluminium to iron results in a reduction in specific magnetism which is roughly in proportion to the amount added as though the addition behaved as an inert diluent. If carbon be present, however, silicon seems to neutralize its action to some extent. (7) The observations on the alloys of iron with nickel and with manganese, or with both these elements, have failed to reveal any simple relation between their magnetism and their composition. It is probable that this is due to the peculiar effects of heat treatment on these substances. When these effects are sufficiently known it may be possible to apply to the manganese and nickel alloys the same kind of magnetic analysis as to the carbon steels.

New York Tunnel Extension.

At the meeting of the Municipal Art Society in New York City, on December 12, the possibilities in the development of the city by co-operation with the transit companies was discussed. Among the speakers was William S. McAdoo, who criticised the recent offer of the Interborough Company to extend its tunnel lines. The two worst features he considered to be the proposed division between the city and the company of the profits after five years of operation and the indeterminate franchise.

The Eight-Hour Law.

The turbo-electric machinery for the new battleship to be built at the Brooklyn Navy Yards has been bid upon by only one company, the General Electric Company, owing to the fact that all competitors were deterred by the application of the eight-hour law. This clause occurred in an act of Congress declaring it to be a penal offense to use labor in excess of eight hours per day by any contractor on any public works of the United States.

A recent opinion has been handed down by the Attorney General, which states that this law should be construed to apply simply to work done upon the vessel itself at the place where it is built, and not to the manufacture elsewhere of machinery or material that is to enter into its construction.

Lewis Institute Branch, A. I. E. E.

At a meeting of the Lewis Institute Branch of the American Institute of Electrical Engineers, held on the evening of December 13 at Lewis Institute, Chicago, a paper was presented on "Some Recent Hydroelectric Developments in the West." As the author, James Lyman, district engineer of the General Electric Company, was unable to be present, the paper was read by Harry Gilbert, of the same company.

Explosion Wrecks Substation of New York Central.

Early in the morning of Monday, December 19, an explosion of gas wrecked the wing of the substation building containing the storage batteries and transformers of the New York Central & Hudson River Railroad at Fiftieth Street and Lexington Avenue, New York City. While shifting a train of cars, owing to a slippery track, the motorman in charge had overrun a buffer and smashed a concrete pillar supporting one of the supply pipes conveying the illuminating gas under pressure to the yard sections. This leakage persisted for several hours and the gas accumulated in a spacious shed underneath the substation. By some means the mixture became ignited, resulting in a terrific explosion which demolished part of the building and caused great damage to the surrounding structures. A street car passing nearby was overturned, crushing an automobile alongside, and killing four passengers in the car. It is understood that ten persons were killed outright and over a hundred persons were more or less seriously injured. Among the railroad men killed were V. B. Livermore, Patrick Jordan and Charles McMorrow.

Virgil Benjamin Livermore was an operating inspector for the New York Central. He was born in Saxon River, Vt., forty-six years ago. He moved to Brooklyn soon after his marriage in 1886 and went to work for the Brooklyn Rapid Transit. He became foreman of workshops. Four years ago he left the Brooklyn Rapid Transit and took a similar position with the Metropolitan Street Railway. A few months later he went into the employ of the New York Central. He leaves a son and two daughters. His wife is dead.

Livermore's work in the electrical equipment department as operating inspector took him to points where there was trouble in the electric system. He was standing by the car which is supposed to have broken the gas pipe.

Patrick Jordan had been in the railroad's employ for twenty years and was general foreman of maintenance of way.

Charles McMorrow was a third-rail man employed by the railroad.

MODERN INDUCTION REGULATORS, THEIR USAGES AND RESULTS.

BY F. W. SHACKELFORD.

When feeder regulators were first introduced the nature of the design led to bulky construction and sluggish operation and they, like other devices, have undergone rapid changes in design, in order to keep abreast of the times.

Induction regulators are designed for single, quarter, three-phase and six-phase work and for hand, motor, or automatic operation. Since the requirements of the times demand automatic regulators, this article will be devoted almost entirely to this class of induction regulators.

The modern induction regulators may be summarized as embodying the following: minimum floor space per unit

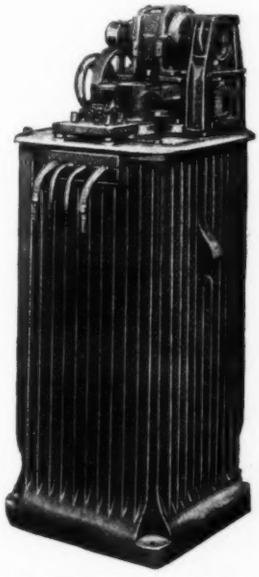


FIG. 1—INDUCTION REGULATOR.

of capacity, noiseless operation both electrically and mechanically, high efficiency and power-factor, perfect balance of moving element, rapidity of operation and elimination of any tendency to hunt.

Such a modern induction regulator is shown in Fig. 1. It will be noticed that the machine is compact, having all parts for its operation self-contained and complete for motor or remote control. For automatic operation the addition of a primary contact as shown in Fig. 4, and a secondary contact which is controlled by the primary contact as shown in Fig. 2, is necessary.

There is always a tendency for any piece of induction apparatus to hum or vibrate and it is, therefore, a question of obtaining a most perfect alignment of the moving part with respect to the stationary part. This is obtained by careful machining of the stationary spider, accurately cut punchings which are assembled in it, and the lining up of the bearings of the rotating member, so that the air gap is equal on any diam-

FIG. 2—SECONDARY RELAY SWITCH.

eter. This insures both a good mechanical as well as electrical balance and the further elimination of humming is accomplished by filling the tank with oil. The stationary part of the regulator is shown in Fig. 3. This shows both the bottom and the top of the tank removed which makes machining of the inside parts much easier and assures accurate boring, inasmuch as the part can be

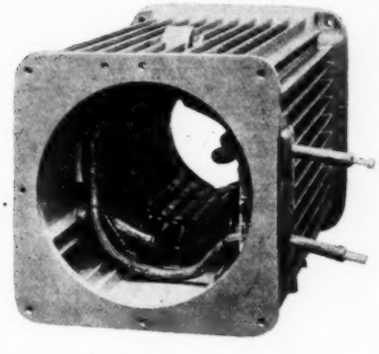


FIG. 3—FIXED PART OF REGULATOR.

bolted fast to the bed plate of the mill and the cutting tool mounted on a shaft of sufficient diameter to insure rigidity. The rotating member or primary is shown in Fig. 5. The windings are mounted on concentric laminated cores as shown in Fig. 6.

The secondary winding of the regulator is connected in series with the line to be controlled and the primary in shunt. The shunt winding or primary produces a magnetic flux that has a constant value, the direction of which is fixed with relation to the movable core, but variable with respect to the secondary core and consequently with respect to the series or stationary winding. This flux when passing through the secondary coils in one direction induces a potential in these coils which is added directly to the line potential, or when the direction of the flux is reversed by rotating the primary core through an angle of 180 degrees is subtracted from the line potential.

It will, therefore, be seen that, as the primary core is rotated gradually, the direction and amount of flux is varied, this variation producing a graduated potential in the secondary from maximum boost, through zero, to maximum buck. Fig. 7 shows the boost and lower curves, the difference between the two

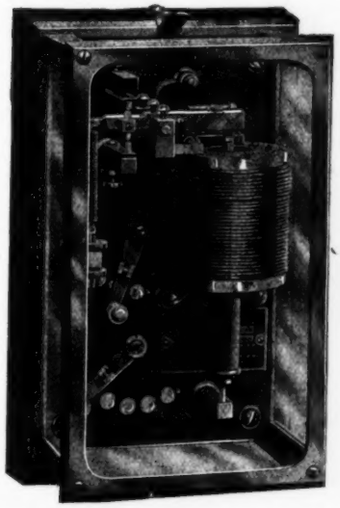


FIG. 4—PRIMARY RELAY CONTACTS.

curves representing the small loss in the regulating device.

The automatic operation of the regulator is effected by an auxiliary contact-making voltmeter, as shown, so connected to a potential and current transformer that a rise or fall of line voltage from a predetermined value will cause contact to be made in the relay switch, this in turn closing the circuit of the small motor which is mounted directly on top of the regulator case and which drives the regulator armature by means of suitable gearing as shown in the previous illustration. The rotating core contains two windings, the active or

shunt winding connected across the line and a secondary winding short-circuited on itself and arranged at right angles to the shunt winding. The object of the short-circuited winding is to decrease the reactance of the regulator; for as the primary and short windings are both on the movable core and approximately fixed at right angles to each other, the flux generated by the primary passes on either side of the short-circuited coil and is, therefore, not affected by it in any way whatever and as

FIG. 5—PRIMARY OR ROTATING PART OF REGULATOR.

there is no flux passing through this coil no current flows in it. This condition, however, is only true when the armature is in maximum boost or lower position with current flowing in the series winding, or in any position of the armature with no current in the secondary. With the armature in the neutral or no-boost or no-lower position, the flux generated by the current in the

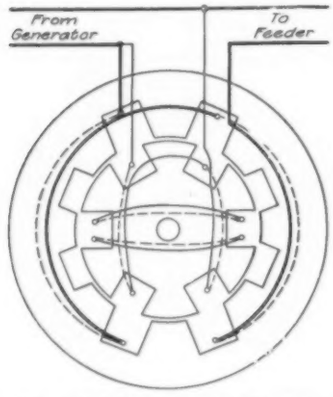


FIG. 6—ARRANGEMENT OF CORES.

secondary passes equally on either side of the primary coils which cannot, therefore, neutralize the flux generated by secondary.

With polyphase regulators the excitation is produced by the combined action of shunt windings connected across the separate phases of the system. All other windings for the different phases must be identical in every way and arranged so that the various windings magnetize the given pole of the regulator in the same direction, that is, each pole is wound with as many distinct and separate windings as there are phases and these windings are connected to the line in the same way as similar windings on the generator. The magnetic flux has a practically constant value, but does not have constant direction, as the magnetic field is a rotating one and not alternating, as in the single-phase type and the speed of rotation of the one particular pole is the same as that of the generator. This type of regulator is sometimes used with three-phase and six-phase rotary converters for lighting service. Regulators, however, are nearly all single-phase, for these may either control a straight single-phase feeder or by using three regulators a three-phase four-wire or three-wire, and by using two, a quarter-phase system.

The features of floor space, of course, involves the relation of height to floor area, when considering any certain power capacity, but it is found that without sacrificing looks, the average floor area per kilowatt of capacity is approximately fourteen square inches.

The efficiency of induction regulators will average 95.5 per cent at full load and 91.5 per cent at one-quarter load. The power-factor at full load is approximately 90 to 92 per cent and varies very slightly from full load to one-quarter load. When it is considered that the capacity of the regulator is usually only ten per cent of the kilowatt capacity of the feeder controlled, such a loss expressed in terms of the total efficiency of the feeder is almost negligible.

TABLE I.

EFFECT OF VOLTAGE VARIATION ON CANDLEPOWER AND WATTS. FIGURES ARE IN PER CENT OF NORMAL.

Per Cent Volts	MAZDA		CARBON	
	Per Cent Candle-Power	Per Cent Total Watts	Per Cent Candle-Power	Per Cent Total Watts
90	67	84	55.9	81.0
91	70	85	59.4	82.8
92	73	86	63.1	84.6
93	76	87	66.9	86.4
94	79	88	71.0	88.3
95	82	90	75.3	90.2
96	85	92	79.8	92.1
97	88	94	84.4	94.0
98	92	96	89.4	96.0
99	96	98	94.4	97.9
100	100	100	100.0	100.0
101	104	102	105.6	102.0
102	108	103.5	111.6	104.1
103	112	105	117.6	106.1
104	116	106.5	124.1	108.2
105	120	108	131.0	110.4
106	124	109.5	138.1	112.6
107	128	111	145.4	114.7
108	132	112.5	152.7	116.8
109	136	114	160.0	118.9
110	140	116	168.0	121.2

TABLE II.

ASSUMED DATA: Each connected lamp used 600 hours per year. Voltage maintained at normal one-half the time and four per cent above normal remaining time. Lamps renewed when eighty per cent of normal candle-power is reached.

Total Number of Lamps Connected	Total Renewals at Normal Voltage	Total Renewals Under Conditions Given	Cost of Excess Renewals at 15 Cents Per Lamp
10,000	7,500	11,200	$ 555
20,000	15,000	22,400	1,110
30,000	22,500	33,600	1,665
40,000	30,000	44,800	2,220
50,000	37,500	56,000	2,775
100,000	75,000	112,000	5,550
500,000	375,000	560,000	27,750
1,000,000	750,000	1,120,000	55,500

The tendency of modern times is to combine light and power and consequently the fluctuation in voltage takes place frequently. In order to meet this condition the induction regulator should be capable of boosting 10 per cent and buckling 10 per cent within 10 seconds. On account of the inertia of the moving element, the driving motor has to develop maximum torque in minimum time and when the voltage regains normal value absolute means of stopping the regulator at this point is necessary. In order to accomplish this end a magnetic brake is provided of the toggle type, the brake being set by gravity and released the moment power is applied to the motor.

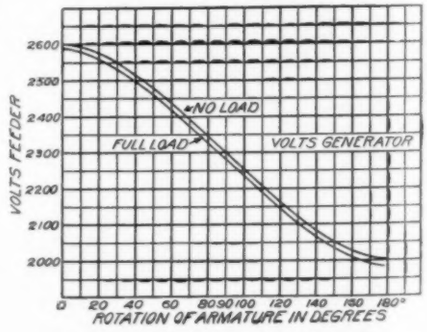


FIG. 7—BOOST AND LOWER CURVE.

Now, as to the usages and results obtained by using automatic induction

regulators, it will be necessary to first show the effect of voltage changes on the incandescent lamp. By reference to Table I and Fig. 8 you will note how the properties of incandescent lamps are affected by such changes in voltage.

First, with reference to voltage in excess of rated lamp voltage, it is shown that if the voltage is maintained at 2 per cent above normal, the candlepower is increased 11.6 per cent, the watts 4.2 per cent and the life reduced 33.6 per cent. In such a case the consumer receives excess candlepower without a proportionate increase in metered current and the company is penalized by greater lamp renewals. With voltages in excess of 2 per cent the conditions are

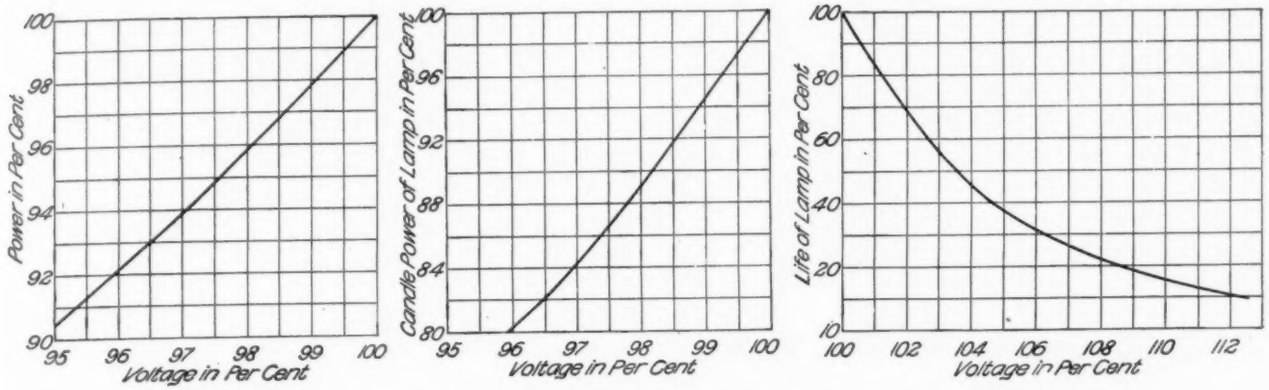

Power in Per Cent
Voltage in Per Cent
Candle Power of Lamp in Per Cent
Voltage in Per Cent
Life of Lamp in Per Cent
Voltage in Per Cent

FIG. 8—CURVES SHOWING VARIATION OF WATTS, CANDLEPOWER AND LIFE WITH VOLTAGE.

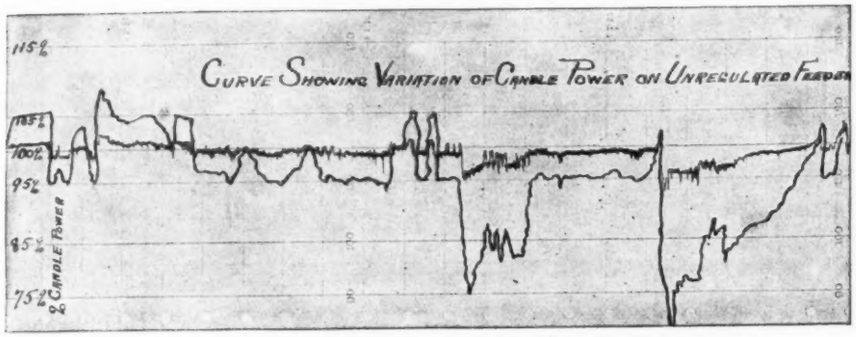


FIG. 9—CANDLEPOWER VARIATION ON UNSTEADY VOLTAGE.

TABLE III.

ASSUMED DATA: Each connected lamp used 600 hours per year. Voltage maintained at normal one-half the time and four per cent below normal the remaining time. Fifty-watt lamps used at 10 cents per kilowatt-hour.

Total Number of Lamps Connected	Anticipated Revenue Per Year	Loss in Revenue Per Year Resulting From the Above Conditions
10,000	$ 30,000	$ 1,200
20,000	60,000	2,400
30,000	90,000	3,600
40,000	120,000	4,800
50,000	150,000	6,000
100,000	300 000	12,000
500,000	1,500,000	60,000
1,000,000	3,000,000	120,000

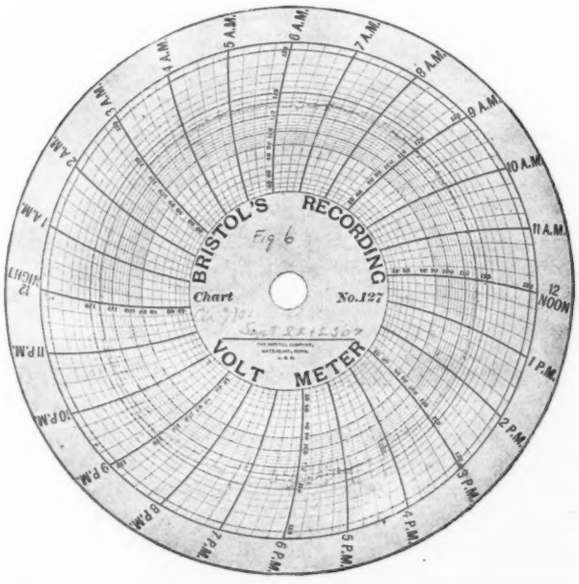


FIG. 10—TWO-DAYS' CHART OF HAND-REGULATED FEEDER.

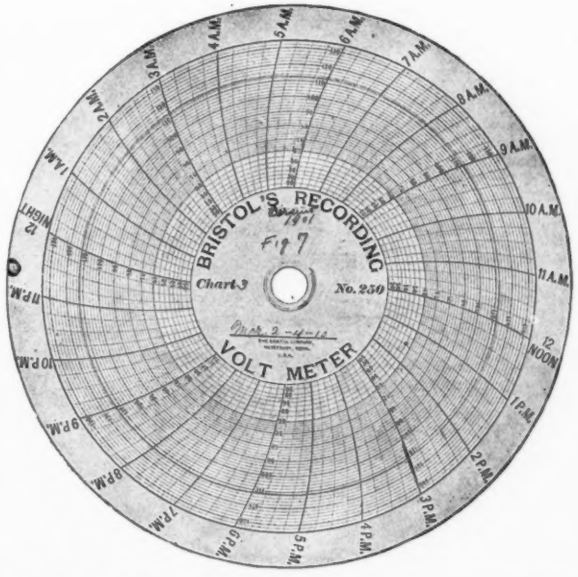


FIG. 11—TWO-DAYS' CHART OF FEEDER WITH AUTOMATIC REGULATION.

more unfavorable to the company. Table II illustrates the cost of excess lamp renewals under the assumed conditions. Where the voltage is below normal rated lamp voltage, it means a direct loss to the station without any compensating features. A 2-per-cent reduction from normal voltage reduces the candlepower 11 per cent, the watts 4.3 per cent and increases the life 53 per cent. In this case the customer's consumed energy is not reduced in the same proportion as the candlepower. Table III shows the actual loss to the station under the assumed conditions.

With fluctuating voltage the illumination given out by the lamps is a variable quantity. This fact is illustrated in Fig. 9, which shows the variation in candlepower plotted against the variation in voltage, the normal voltage being taken at 115 volts. In analyzing this curve it is interesting to note the efforts of the operator to hold up the voltage as the peak came on. In Fig. 10 is shown a two-days voltage chart which was regulated by means of a hand-controlled regulator. The advantage, therefore, of the automatic induction regulator is shown in Fig.11, which represents the same feeder later controlled by the automatic regulator. This chart was also of two-days duration and the accuracy of the regulator is demonstrated by the fact that there is scarcely any point of the curve which does not coincide with the line of normal voltage.

[EDITOR'S NOTE.—In this article the author has described and illustrated apparatus manufactured by the General Electric Company. In our next issue there will appear an article by Mr. E. E. Lehr entitled "Single-Phase Feeder Regulators," in which apparatus made by the Westinghouse Electric & Manufacturing Company will be illustrated.]

Electrical Engineering Society of Massachusetts Institute.

At a meeting of the Electrical Engineering Society of the Massachusetts Institute of Technology, held in Boston, December 2, J. W. Lieb, vice-president of the New York Edison Company, spoke on the subject of "Engineering Ethics."

Wireless in the Court Room.

In the suit being argued in London, brought by Marconi against the British Radiotelegraph and Telephone Company, for patent infringement, wireless apparatus is operated in the court room, an antenna having been erected on the flagpole of the building.

Haverhill Rejects Municipal Ownership.

The voters of Haverhill, Mass., at the regular city election on December 6 rejected by a vote of 4,755 to 1,534 the proposal of the City Council to municipalize the plant of the Haverhill Electric Company. The verdict of the voters was rendered after a short but vigorous campaign of education which was conducted by the opponents of municipal ownership during the week preceding the election, and which, while not intended to do so, came very near accomplishing the defeat of the present city administration.

Haverhill has had two Socialist mayors in recent years, and its electorate, composed largely of shoe workers, is generally supposed to entertain somewhat radical political ideas. This led many people to assume that the voters would embrace this opportunity to try out municipal ownership. The vote of the Council in submitting this proposition to the people had been unanimous, and at the primaries only a month previous to the election Mayor E. H. Moulton and the other members of the Council whose terms expired qualified by a vote of about five to two over their opponents. A number of large tax payers and business men took up the fight in the electric company's behalf, their action being based on the fear that increased taxes would result from the experiment. They were ably assisted by the two Haverhill newspapers, *The Gazette* and *The Record*, which throughout the campaign published editorials and news articles dealing with the subject of municipal ownership, both from a local and a general standpoint.

Perhaps the most effective argument with the laboring element was the one to the effect that whereas only 500 families in Haverhill use electricity, the cost of the plant, estimated at $1,000,000, would fall on the entire community, while the gas plant, which Mayor Moulton refused to municipalize, served 7,000 families and could be purchased for about $500,000. J. W. Bean, Mayor Moulton's opponent, was not slow to take up this argument, and aided by ex-Mayor Roswell Wood, a candidate for councilman, soon placed the administration on the defensive. Two days before the election the Council issued a statement explaining its attitude regarding the gas and electric plant and contending that the acquisition of the latter should be undertaken first. This statement evidently had very little weight with the voters, as was witnessed by the vote of over three to one against the proposal, the election of Mr. Wood over Councilman Desmond and the narrow escape of Mayor Moulton himself, who received a majority of only 243, despite the fact that his administration was generally considered to be highly efficient.

Throughout the campaign the Haverhill Electric Company, which is controlled by C. H. Tenney & Company, of Boston, Mass., apparently ignored the fact that its future existence was at stake and its newspaper advertising contained no reference to the subject of municipal ownership. By means of its advertisements, however, it was able to foster a friendly spirit and to introduce many facts which indirectly, at least, had a bearing on the question before the voters. Among these facts were the following: That, since the present owners came into control of the property six years ago, the Company's service had been absolutely satisfactory to the public; that the base lighting rate had been voluntarily reduced from 20 cents to 12 cents, while the price of other commodities had been raised; that an additional investment of $600,000 had been made within six years for improvements, many of which were not revenue-producing; that its rates and service compare favorably with those of any other city in the country where similar conditions prevail; that complaints were almost unknown and that all grievances were promptly attended to; that, whereas its plant investment was sufficient to light all of the homes in Haverhill, its service was used by only 500 families.

Attendance at Lewis Institute.

The present quarter at the Lewis Institute, Chicago, shows the largest number in attendance in the history of the Institute, 2,700 being registered, counting both day and evening students. Of these 160 are in electrical engineering. There are 550 men and boys in attendance in the day school, most of whom are taking engineering or studying in preparation for engineering.

An evening course in Gas Engines is announced for the winter quarter, beginning January 3.

ELEMENTS OF POWER-STATION DESIGN.—XVII.

OVERHEAD TRANSMISSION AND LINE CALCULATION.—II.

BY W. B. GUMP.

The capacity formula is more complex and space does not permit its derivation here. In calculating the capacity of a transmission line there are several methods employed. One of the most common is to consider the line as a condenser whose capacity is concentrated at the ends. A somewhat more accurate result is obtained by assuming the capacity shunted across the line at the central point, or midway between the generator and receiver. Such an assumption is accurate within one per cent in a 200-mile line. Extreme accuracy in the matter of capacity can only be had by dividing the line into a very large number of parts. This is because each infinitesimal portion of the line has a different voltage. Furthermore, there is an actual leakage of current between the conductors, and the value of this current varies with the distance from the generator. The error may be reduced to almost an inconsiderable quantity by regarding the total capacity divided so that one-sixth is shunted across at each end, and the remaining four-sixths are shunted across at the center. In the line under consideration we shall assume, for simplicity, that the capacity is concentrated across the center of the line.

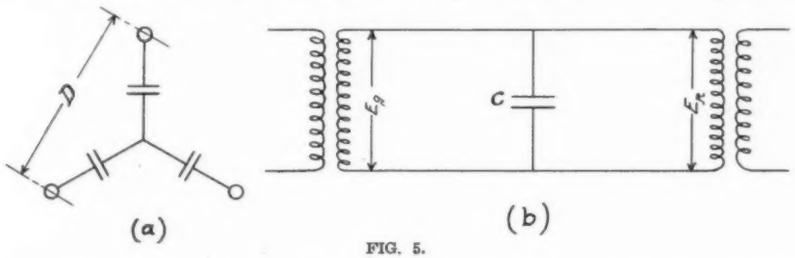


FIG. 5.

The capacity in micro-farads per loop of circuit per mile for either single or three-phase is

$$C = \frac{0.194}{\log_{10}\left(\frac{D}{r}\right)}$$

when D and r are in inches.

In a three-phase line the effect of capacity is equivalent to three condensers inserted as shown in Fig. 5 (a), the zero or neutral point being equidistant from the respective conductors forming an equilateral triangle.

The charging current is

$$I_c = 2\pi f C E \times 10^{-6}$$

For a three-phase line the charging current is $2/\sqrt{3}$ times that of a single-phase line of equal length. One phase of the line under consideration may be represented by the diagram Fig. 5 (b), in which it will be assumed that the inductance is uniformly distributed all along the line, and the capacity so arranged that one-half the charging current flows over the entire line; which is the equivalent of the full charging current flowing over half the line. For convenience in calculating transmission lines, tables are ordinarily used, giving constants for self-induction and capacity. In the present calculation the use of tables has been purposely avoided.

We shall now proceed with the calculation, taking up first self-induction. Assume the conductors spaced equilaterally eighty-four inches apart.

Then substituting values in the preceding equation, we have

$$L = \sqrt{3}\left(.01524 + .14 \log_{10}\left(\frac{84}{.2048}\right)\right)$$

=.662 millihenries per thousand feet or 5.28×.662=3.49 millihenries per mile.

Inductive reactance in ohms is

$X=2\pi fL\times10^{-3}$.

$=2\pi\times3.496\div1000$.

=.55 ohms per mile per phase.

70×.55=38.5 ohms per phase of entire line.

The reactance drop per phase is obtained by multiplying the above value by the current. An approximate method sufficiently close for practical purposes is shown in Fig. 6 in which the values are plotted graphically. The notation is as follows:

I_R= current in the line.

I_w = wattless component of current.

I_P= power current.

Cosθ is .85, as assumed in the foregoing data.

I_c = charging current at receiving end.

E_g = voltage at generator.

X = reactance.

R = ohmic resistance.

All of these quantities relate to full-load conditions.

The charging current is

$$I_c = \frac{2}{\sqrt{3}}\left(\tfrac{1}{2}\,2\pi f C E_R\right)10^{-6}$$

$$= \frac{2}{\sqrt{3}}\left(\pi f\left(\frac{.0194}{\log_{10}\left(\frac{D}{r}\right)}\right)E_R\right)10^{-6}$$

Reduced I_c = 3.8 amperes per phase.

To determine the potential required at the generator we must ascertain the volt drop due to:

(1) The power component of the load.

(2) Wattless component.

(3) Charging current.

These must then be added vectorially.

The expression for the first (power component) is

$E_R=I\times R^P=66.3\times23.6\times\sqrt{3}=2{,}720$ volts, which is in phase with the current.

Wattless component in phase with power current:

$XI_w = 38.5 \times 37.2 =$	1,435 volts
	2,720 volts
$AB =$	4,155 volts

In quadrature:

$RI_w = 41 \times 37.2 =$	1,525 volts
XI_P=38.5×68.3=	2,550 volts
$BC =$	1,025 volts

Therefore

$$E_g = \sqrt{(E_R + AB)^2 + (BC)^2}$$
$$= \sqrt{(84{,}155)^2 + (1{,}025)^2}$$
$$= 84{,}160 \text{ volts.}$$

Power-factor at generator is

$$= \frac{\text{Rated K.W. output}}{\text{K.V.A.}} = \frac{10{,}000{,}000}{\sqrt{3} \times 84{,}160 \times I_g}$$

$I_g = \sqrt{(66.3)^2 + (37.2)^2} = 76$ amperes

Then

$$p.f. = \frac{10{,}000{,}000}{\sqrt{3} \times 84{,}160 \times 76} = .90$$

A summary of the above data is tabulated as follows:

ASSUMED.	
Three-phase transmission.	
Load at generator	10,000 K. W.
Distance of transmission	70 miles
Receiver voltage	80,000 volts
Frequency	25 cycles
Power factor of load	.85
Size of conductors (copper)	No. 000 stranded
DETERMINED.	
Generator voltage	84,160
Full-load drop, referring to generator voltage	4.95 per cent
Full load drop, referring to receiver voltage	5.2 per cent
Power factor at generator	.90

It should be noted that the foregoing calculation has not taken into account the skin effect, since this is not usually a considerable quantity in the case of lines less than 100 miles in length. In long lines, however, it should always be included as one of the refinements necessary in obtaining accurate results. Another point to be mentioned is the fact that stranded conductors do not have the same coefficient of self-induction as solid conductors, the difference being due to the effect of the individual wires forming a stranded conductor. In order to lesson complexities in the present case, no distinction was made between the stranded and the solid conductor. It should be noted that the regulation of the line just computed is far better than would be the case with a frequency of sixty cycles. The difference is readily determined by recalculating for the latter frequency.

(f) The problem of determining the most economical span next presents itself. In considering this question the first thing to be noted is the duty imposed upon the supporting structure. A tower (or other form of support) must be designed to withstand:

(a) Its own weight.

(b) Resistance to wind pressure.

(c) Resistance to strains of the line.

For every transmission line there is a certain span which is the most economical. In determining the most economical span the question of the cost of towers is necessarily among the chief items, since the cost of towers, and hence the total cost, will vary with the length of span. In sections of the country where wood poles are easily obtained their first cost is not serious as compared to that of steel towers. Hence, the initial investment is much lower. The question of maintenance, however, is so much higher for poles than for towers that the latter are chosen for nearly all transmission systems involving distances above seventy-five miles, since permanency of construction is the thing sought in long-distance lines.

Concrete towers have been used to a limited extent, and are increasing in popularity. When constructed properly they are absolutely permanent, and are superior even to steel towers in this respect. On account of the necessity of reinforcing, it becomes objectionable under the usual conditions to construct both a steel framework and a superimposed concrete structure, which in reality about doubles the amount of material required, and increases the cost of labor. These factors form the principal barrier to the universal use of concrete at the present time.

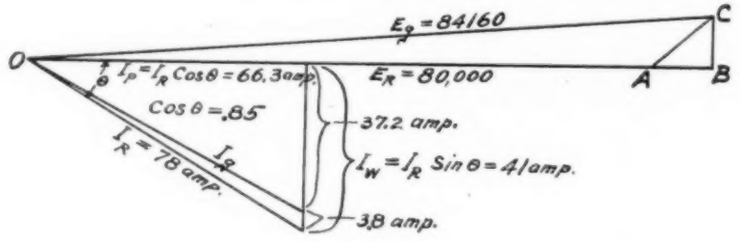


FIG. 6.

It is not the purpose here to enter into the analysis of stresses, but merely to give the general method to be followed in arriving at a definite conclusion regarding the span. Returning to the three factors first given we have:

Total weight:

$W = W_1 + W_2 + W_3$ in which,

W_1 = weight necessary for self-sustaining.

W_2 = weight necessary to resist wind pressure.

W_3 = weight necessary to resist strains of the line.

Each member of the tower is therefore made up of these three items, each of which should be computed separately, and finally combined. It is generally best to turn this portion of the design over to a structural-steel specialist who is experienced in the analysis of framed structures. Great care must be exercised in making assumptions for wind, snow and ice, as well as other climatic conditions, since these elements are so variable in certain localities that they have a marked influence upon the character of design required.

For potentials above 60,000 volts the suspension type of insulator is generally used, in which case line conductors have greater latitude in which to swing. Consequently the spacing between conductors must be increased, on account of the danger of contact. The distance between towers usually ranges from 500 to 800 feet, while with wood poles the maximum distance is about 150 feet. As a rule, there are at least fifty poles per mile, as against ten or twelve steel towers. Moreover, the danger of burning off poles is very serious. Also, on account of the increased number of insulators required, the likelihood of interruption is greatly increased by using poles.

It is important to remember that the towers for a given transmission line are not likely to be uniform, particularly in a mountainous country, and for this reason it will be found necessary to employ a large number of specially constructed towers which shall conform to certain respective localities. For example, if a line is to transverse a region which has both level and mountainous portions, it may be found that sixty-foot towers will be required on the level, while forty-foot towers will be ample at other points, provided that the undergrowth does not extend to a dangerous height. These conditions contribute to more or less uncertainty regarding the cost of labor, which is necessarily far from uniform.

In concluding this item, mention should be made in connection with anchoring and guying of towers. No matter how carefully the towers are designed, their true character is not fully tested until they have been erected and have become subject to all of the working conditions, one of which is the strain imposed by the lateral pull of the line

and of guy wires. The most extreme condition occurs when the line conductors become separated and all the stress is allowed to come on one side. With the pin-type of insulator, the pin is the first member to be put under stress, next follows the cross-arm, and finally the tower, which tends to fall, pulling out anchor bolts, tie rods and breaking guy ropes, if these are inadequate to the strain. Where one conductor becomes separated, the tendency is to twist the tower by swinging the cross-arm to a position parallel with the line. Several cases can be cited where sad experience has resulted from lack of precaution given to the matter of erecting.

(g) The investment, maintenance and depreciation of a transmission line are items of great importance in relation to high-tension power economics, and should be considered most thoroughly.

Let us consider the line just calculated, basing figures upon the following data:

Steel tower construction.
Spacing of towers 550 feet.
Height of towers 60 feet.
Suspension-type insulators.

672 steel towers at $70.00 each	$47,040
3×672 insulators at $3.50 each	7,056
Line conductors	96,000
Erecting at average of $20.00 each	13,440
Total investment	$163,536

Suppose we assume a rate of interest of five per cent per annum. Then from the equation

$$d = \frac{100\ r}{(1+r)^N - 1}$$

we have the rate of depreciation in per cent of first cost

$$d = \frac{100 \times .05}{(1+.05)^{25} - 1} = 2.1 \text{ per cent.}$$

in which N is the assumed number of years of life of the line equipment (not including insulators). This means that if 2.1 per cent of the initial investment is laid aside each year, and is compounded at five per cent, it will equal the investment at the end of twenty-five years. The sum laid aside for such purposes is ordinarily termed a sinking fund when referred to in connection with a bond issue for the building of a power system.

Suppose we consider taxes and insurance to the amount of one per cent, making an annual charge of $1,635.36. If the cost of renewals amounts to $800.00, and the cost of patrolling the line is $2,000.00 per year, the total annual charge is made up as follows:

Depreciation, 2.1 per cent	$3,434.25
Taxes and insurance, 1 per cent	1,635.36
Renewals per year	800.00
Patrolling the line	2,000.00
Total	$7,869.61

The last item is a matter deserving a great deal of attention. Its importance naturally increases with the length of the line. It may be said that at least two men are necessary, and they should each have a relay of horses, the number depending upon the length to be traveled. Patrolling on horseback is satisfactory for lines not exceeding thirty miles, but this method does not usually work out well for long lines, since a horse becomes too fatigued after carrying the rider any great distance. It will be found that driving a light team is far superior to horseback for long distances.

The foregoing treatment has not touched upon one of the leading items relating to a transmission line, and this is the telephone system. In conclusion, it is well to state that a great deal of study is required to secure efficient telephone service, and its importance cannot be overestimated. This subject alone is a broad one and cannot be discussed here in detail. The problems to be solved in connection with this part of the system will be found to include the judicious arrangement of telephone stations as well as the matter of eliminating cross-talk and designing protective devices.

(To be continued.)

[EDITOR'S NOTE.—This important series of articles was started in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, September 3, 1910, and will cover every phase of central-station design. The treatment is elementary and withal practical throughout, and the complete series will constitute a standard and reliable treatise on this important subject.]

Central Station After the Farmer.

A few years ago, in the memory of all of us, electricity was looked upon as a very great luxury. Later it came into more general use, and gradually worked its way into the factory and home, in towns and cities, until now it has become classed among the necessities of life in all towns of 300 population up. Now some enterprising central-station managers are looking with longing eyes even at the farmers or ranchers, as they are called in the Northwest, and one of the central-station men has made a start in that direction during the past month.

At Walla Walla, Wash., in one of the rapidly opening fruit sections, the Pacific Power & Light Company has a plant and serves that city and four other smaller towns in Oregon, among which is Freewater. During the past six weeks, Manager Foshay of the Power Company, together with his power solicitor, R. F. Fisher, and his local agent at Freewater, Geo. Sanderson, have worked up an extension into what is known as the Houson Bay Country, to furnish power for pumping water for irrigation purposes.

The proposed line is now an assured fact, there being some 450 horsepower signed for, together with many lighting contracts.

The substation at Freewater will feed this line, which will be some ten miles in length, with laterals taken off at various places. It will be operated at 6,600 volts. No secondary lines will be run, each consumer having his own transformer, and dropping from it direct to pump house, or home, with the secondary. This is done to save line loss and the expense of long secondary lines, as the consumers are some distance apart.

All this business, that is the power, is off-peak business. The contracts call for a demand charge of $12.00 per year per horsepower, and besides, a charge of three cents per kilowatt-hour for the first 60 hours use of connected load per month, two cents per kilowatt-hour for the next 60 hours, one and three-fourths cents per kilowatt-hour for the next 60 hours, one and one-half cents per kilowatt-hour for the next 90 hours, and one cent per kilowatt-hour for all over 270 hours use per month of connected load. Consumers are compelled to furnish time switches at their own expense, keys are retained by the company, and for four hours over the evening peak the current is cut out. Such business helps to take out the low places in the load curve of the central station's power plant.

Submerged Coal Storage Bin Being Built in Omaha.

The Omaha Electric Light and Power Company is building a concrete lined coal storage pit to hold 5,800 tons of coal. It is to be 117 by 100 feet in area and 22 feet deep. A crane will lift the coal when ready for use. The pit was designed by Sargent & Lundy, engineers, of Chicago, and will cost about $88,000.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

Tungsten Lighting in Prospect Park, Brooklyn.

The installation of 750 ornamental posts, each bearing a twenty-five-watt tungsten lamp, has been completed in Prospect Park, Brooklyn, N. Y. These replace 150 gasoline mantle lamps, which were not only antiquated in character, but entirely inadequate in illumination and lacking in artistic value. The new lamp posts are quite similar to those in Central Park of the metropolis, but are improved in detail so as to facilitate cleaning of lanterns and renewal of lamps. They are placed 100 feet apart on alternate sides of the driveways and to suit local conditions along the footpaths. The lamps are grouped about fifty in each series circuit. Current is supplied by the Edison Electric Illuminating Company of Brooklyn. The engineering work was done by co-operation of the Company's staff and those of the various municipal commissions and boards concerned in the improvement. It is conceded by all that the new lighting is pleasing, effective and a marked betterment over the old.

Cluster Lighting for Walla Walla, Wash.

Some three months or more ago, the Pacific Power & Light Co., of Walla Walla, Wash., installed fixtures of three lights each on six trolley poles in the block in which its office is located. This installation was made as a demonstration, and as a result the city has about decided to install 138 of these fixtures, there being six to the block, which will put them on twenty-three blocks. The installation is unique, inasmuch as 110-volt multiple tungsten lamps are used without shock-absorbers. The six clusters containing eighteen lamps have burned every night from dusk to midnight since the middle of July, and up to the middle of December, or during five months, not a single lamp has been broken from the vibration or jar of the trolley poles.

The idea was not looked upon with favor by the company whose lamps were used, but the results have proven that this type of lamp can be used

COMBINATION POLES IN RESIDENCE DISTRICT.

under more severe conditions than most people, even the lamp manufacturers themselves, believe.

The poles are those used for the trolley line, and are made up of a lower section, twenty feet high, of six-inch cast-iron pipe, with a six to four-inch reducer, and a top section of ten feet of four-inch pipe, which is topped off with a ball top in which is inserted a pin. A twin, No. 6 weatherproof conductor is used, one on each side of the street, and the lamps are fed from this, the wires entering at the top of pole and running down through the same to the fixture. Thus, all that is exposed to view is a single wire, from pole to pole, on each side of the street. The effect is very good, and the cost of installation, including wire, fixtures, lamps, and twelve-inch opalescent globes, and also including cost of installation, is only about $30 per pole. Each fixture is equipped with three sixty-watt tungsten lamps.

COMBINATION POLES IN BUSINESS DISTRICT.

The plan on which the installation has been proposed, is that the city contract for the new lamp on a ten-year contract, at a price per pole to include installation, lighting and maintainence. The matter has been agitated considerably, and Mr. Foshay, the company's manager states that he has great hopes of securing the contract at an early date.

Efficiency of Incandescent Lamps.

For a number of lamps now on the market, data have been determined by G. Leimbach, as shown in the table where *A* represents the specific consumption of watts per mean candlepower, *B* the relative radiating power, that is, the energy value of the total radiation divided by the energy consumed, *C* the luminous effect, that is, the energy value of the luminous radiation divided by that of the total radiation, *D* the efficiency, that is, the energy value of the luminous radiation divided by the energy consumed.—*Journal of the Franklin Institute.*

	A	B Per cent.	C Per cent.	D Per cent.
Carbon lamp	3.8	61.9	2.85	1.75
Nernst lamp	2.0	49.2	4.43	2.17
Tantalum lamp	2.0	64.8	4.26	2.75
Osram lamp	1.5	75.6	4.63	3.50
Tungsten lamp	1.7	72.2	4.44	3.20
Sirius colloid lamp	1.5	65.4	5.42	3.55

Tantalum lamps are being largely used on ships by English shipbuilders.

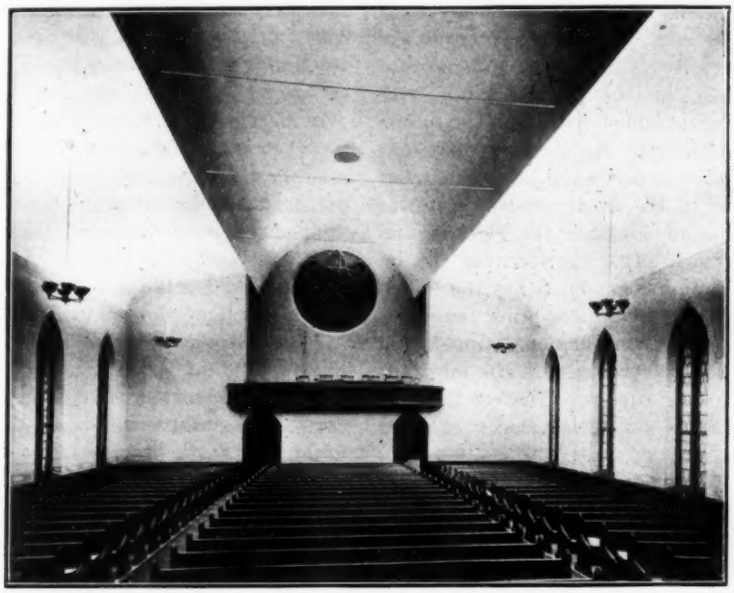
INDIRECT LIGHTING OF CHURCHES.

A MODEL INSTALLATION AT ROME, N. Y.

It is safe to say that there are few places where the need of improvement in quality of illumination is greater than in our churches. Doubtless most church goers and even ministers are unaware of this need because the knowledge of what constitutes good illumination is still possessed by too few of them and the opinion that there is needed a liberal supply of chandeliers and wall brackets with exposed lamps near the line of vision is still too prevalent.

Anyone who has stopped to consider the matter will admit that anything which produces discomfort or distraction to a person will prevent him from concentrating his mind on anything. This is strikingly evident in a church where all the mental and spiritual faculties of the devoted should be concentrated on the services. It has long been realized that uncomfortable pews and bad ventilation produce feelings of restlessness and lassitude. More recently it has been noticed that exposed lights near the pulpit create both discomfort and distraction. The glare from such lights tires the eyes and one finds them instinctively closing for the rest this affords. On some persons steady gazing at lights produces a sort of hypnotic effect which only too often produces slumber. Thus the minister is not always to blame when his sermon is not attentively listened to. In fact exposed lights in the body of the church have a similar effect on him and prevent him from doing his best.

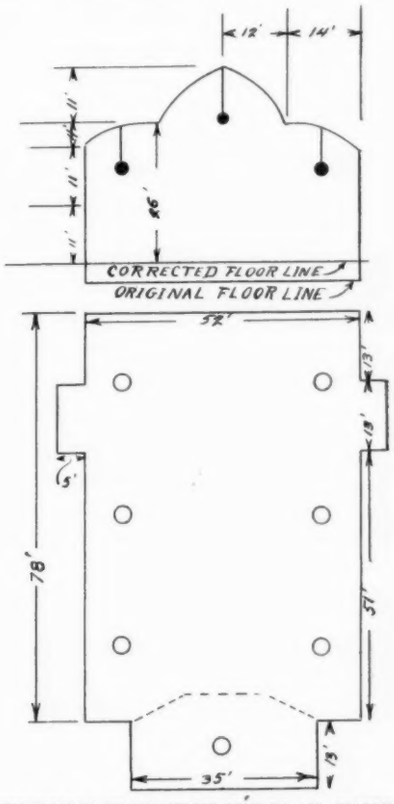
A hopeful sign of the times in matters of illumination is the awakening that has taken place to the injurious effects of glare. There are quite a number of churches in which this factor in the lighting problem has recently received cognizance. As a result there are now several houses of worship in various parts of the country in which indirect lighting has been very successfully employed, thus producing an illumination that is at once restful, soft and mellow, as is peculiarly appropriate in a church.



INDIRECT LIGHTING IN FIRST BAPTIST CHURCH, ROME, N. Y.

A typical installation of this kind is in the First Baptist Church of Rome, N. Y. A sum of money for improving the church edifice was donated by a friend. Among the improvements readily provided from this fund were a new hardwood floor and new decoration of the interior. It was desired to install a new lighting equipment to take the place of the low-hanging chandeliers on each side of the church and of the wall brackets near the pulpit. It was first proposed to place high-power lamps near the ceiling, but after further investigation an indirect lighting equipment was contracted for.

The accompanying illustrations show how the lighting problem was solved. The vaulted character of the ceiling complicated the calculations. Advantage was taken successfully, however, of the cove-like manner in which the ceiling meets the side walls; by placing three fixtures on each side abundant reflection was secured to illuminate all the pews evenly. One fixture was placed over the pulpit. Each fixture supports six concentrating reflectors containing each a 100-watt Mazda lamp. The engineering specifications required that the lamps be mounted with the tip nine feet from the ceiling. The resulting illumination was



SECTIONAL ELEVATION AND PLAN, SHOWING LOCATION OF INDIRECT FIXTURES.

2.5 foot-candles at the pews, although in most churches it is not over 1.75 foot-candles.

The installation was designed and the indirect fixtures supplied by the National X-Ray Reflector Company, of Chicago. The equipment was installed and current furnished by the Rome Gas, Electric Light & Power Company. The pastor of the church is the Rev. Alfred E. Alton, who stated recently that the lighting committee had serious misgivings about how the work would turn out but was happily surprised at its completely succesful outcome.

Chicago Section, Illuminating Engineering Society.

The December meeting of the Chicago Section of the Illuminating Engineering Society was held at the Great Northern Hotel, Chicago, on December 15. Directly after luncheon a paper by J. M. Bryant and H. G. Hake, of the department of electrical engineering, University of Illinois, on "Comparative Costs of Producing Light with Different Illuminants" was read by Mr. Hake, who elucidated the subject by the aid of several charts and curves.

In this paper a comparison of operating costs and renewals is made between forty-one types of lamps, thirty-one being electric and the remaining gas, acetylene, kerosene, gasoline and alcohol lamps. The basis of comparison was the actual cost of producing 100,000 lumen-hours, including the necessary renewals of lamps or parts of lamps. No account was taken of the light distribution, effect of shades and reflectors, or other factors that are of moment in any problem of illumination. The authors point out the importance of considering such other factors in the selection of any illuminant, since operating cost is not the sole criterion. But in order to avoid too complex a comparison, the cost of burning and maintaining the lamps was considered alone.

The thirty-one electric lamps considered as given in the order of resultant cost with electrical energy at ten cents per kilowatt-hour are: Regenerative direct-current 5.5-ampere series and multiple arc lamps; magnetite direct-current 6.6-ampere series arc; direct-current 10 and 8-ampere flame arcs with inclined carbons; mercury-vapor 3.5-ampere multiple arc-direct-current 8-ampere flame arc with vertical carbons; luminous direct-current 6.6-ampere multiple arc; direct-current 9.6-ampere series open arc; magnetite 4-ampere series arc; alternating-current 10-ampere flame arcs with vertical and inclined carbons; direct-current 6.6-ampere series open arc, tungsten 6.6-ampere series incandescent; alternating-current 10-ampere inclined-carbon flame arc; direct-current 6.6 ampere inclosed series arc; luminous 4-ampere multiple arc; tungsten multiple incandescent; Nernst alternating-current three-glower lamp; similar direct-current lamp; inclosed series alternating-current 7.5 and 6.6-ampere arcs; tantalum direct-current and alternating-current multiple incandescents; carbon 3.1-watt multiple incandescent; carbon 3.5-watt 6.6-ampere incandescent; carbon 3.5-watt multiple incandescent; inclosed direct-current 5 and 3.5-ampere multiple arcs; inclosed alternating-current 6 and 4-ampere multiple arcs.

As the order of the preceding list is somewhat changed when different current rates prevail, two sets of curves of the principal electric illuminants were drawn to show the variation of the operating costs with the rates varying from zero to twenty-four cents per kilowatt-hour, one set applying to series and the other to multiple lamps. Other charts showed the order graphically.

Similar comparisons were made with open-flame, upright-mantle, inverted-mantle and four-mantle "arc" gas lamps; also flat and round-flame and mantle kerosene lamps; and with acetylene, alcohol-mantle and gasoline-mantle lamps. As these comparisons were also made on the basis of cost of producing 100,000 lumen-hours, it was possible to compare the electric and gas lamps. This showed that the inverted-mantle gas lamp has the lowest cost of any illuminant other than electric and that in bare operating cost it compares favorably with the most efficient electric lamps. The candlepower of gasoline lamps is usually exaggerated.

At the conclusion of the paper a number of questions were asked to which Prof. Bryant replied that the candlepower tests were made on new lamps, but after they had reached a steady or fairly average value. Although in most cases the comparison was based on actual tests made in the University of Illinois laboratories, in some instances manufacturers' data were used, but in these cases it was only when such data checked with those given by several disinterested authorities. Flame-arc tests were made with opal globes. No allowance was made for broken globes.

Ward Harrison, of Cleveland, Ohio, stated that tests made by the National Electric Lamp Association showed that the average candlepower of arc lamps between trims is about eighty per cent of the initial candlepower; with flame arcs it is about seventy per cent; Cooper Hewitt mercury lamps about eighty per cent; and for various types of incandescent lamps about ninety-one per cent of initial has been found a fair average value. In considering comparative costs of various lamps, the initial cost of each lamp and the fixed charges on the installation must be considered. New lamps are being frequently put on the market and it is not likely that the average life of even expensive lamps is more than eight years. Consequently the interest, depreciation and other fixed charges are likely to form a heavy charge against an expensive equipment. The consumption of pilot lamps should also be charged against gas equipments. In gas lamps the average candlepower has not exceeded seventy per cent of rated value, even with the best mantles. Maintenance of mantle lamps causes considerable trouble. Thus, when all these factors are taken into account, gas does not make a better showing than electricity.

In reply to a question Mr. Hake stated that no auxiliary reflectors were used in the tests, therefore the comparison made was more just for interior lighting than for exterior lighting. A comparison on the basis of effective lumens would make a material change with several of the lamps considered.

A. L. Eustice also called attention to the need of considering the mean lower hemispherical efficiency in any comparisons of this kind. The distribution of some lamps is almost entirely downward, thus obviating the cost and loss due to reflectors. He endorsed Mr. Harrison's remarks in most particulars. He also felt that the paper did not give sufficient data about the lamps and the character of the tests made. As the figures given relate to new lamps, or lamps almost new, they do not represent the average performance of a lamp.

Among others who discussed the paper were A. Scheible, C. M. Axford, T. H. Aldrich and Chairman Pearson. The discussion was closed by Prof. Bryant, who explained many points about the paper. It was attempted to compare the lamps on the basis of the total amount of light given by the light sources. As to how this is effected by reflectors is fairly well known. Questions of color, flickering and other features are apt to make an efficient lamp unsuitable for some services. The gas consumption in pilot lamps was considered.

TELEPHONY—TELEGRAPHY, and WIRELESS.

RESEARCHES ON THE TRANSMITTER AND ON LONG-DISTANCE TELEPHONY.[1]

BY BELA GATI.[2]

Although the first written references to the human language date back 6,000 years, we have for nearly 6,000 years done almost nothing to obtain a knowledge of speech. It was not until the modern time, when international trade took an enormous leap and when the twentieth-century merchant began to transact business at a distance of several thousand kilometers by way of telephone, that researches have been made in the interest of telephony at such distances, researches which submit the human speech to an examination more minute than has ever been the case before. Of great importance to long-distance telephony is the microphone, which, by the action of the voice, controls an electric current in the conductors. Considering that we do not know the elements which go to make up language, the means of changing this unknown thing into the form of electricity thousands of kilometers away, has imposed a task nearly unsolvable to those who occupy themselves with these questions. Nevertheless, after having perseveringly made experiments, they have succeeded in awakening a hope of a solution of that question, and I should like to speak briefly of the results of the researches obtained up to the present time.

The examination of the vowels of our language has occupied phoneticians for more than ten years. The tests made permit us at present to believe with certainty that the vowels arise from the simultaneous production of certain —sometimes more, sometimes less, but in every case of several—musical tones of different intensity and pitch.

Returning to the transmitter, we can commence its examination in the most simple way, that is to say, by exciting before the diaphragm not several different tones, but only one, at the same time sustaining an intensity which is very nearly constant. From the measurement of the alternating current generated in the secondary coil we can make our conclusions as to the performance of the transmitter with this particular sound. By the repetition of this test with another sound of different pitch, we may observe the behavior

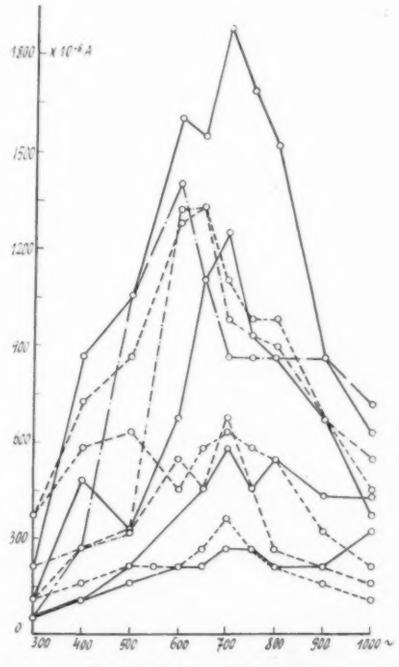


FIG. 1.—RELATION OF CURRENT TO FREQUENCY IN HUNGARIAN TRANSMITTERS.

of the transmitter with this other sound. Thus we can by a series of trials with several different sounds examine the action of the transmitter, and determine according to the behavior of the transmitter with different sounds a certain law for this action.

Thus, as explained, the principle is simple and easily understood, but the execution is difficult. To begin with, it is nearly impossible to find a source of sound which can be maintained at even intensity; above all, we must be able to vary the pitch of the sound at will. After having made tests for several years I have found that the best source of sound is one designed by Stern. In this apparatus intensity of the sound is very constant. The pitch may be easily varied, and the management of the device is very simple.

After finding a suitable source for the currents it was necessary to provide for the measurement of alternating current. At the time of commencing this work (1903) the measurement of weak currents was not developed at all. A reflecting electrodynamometer, by the use of which the telephonic current could be measured, at that time seemed to be very accurate. But the development of the barretter made the work very simple, and now this measurement can be very easily accomplished. How many researches, without a correct method, pursue an entirely false direction is well shown by Campbell's tests. He did not possess any sufficiently sensitive means for measuring the intensity of alternating current; instead, he measured the voltage with the aid of an electrostatic reflecting voltmeter, and hence met with many difficulties. He was forced to use very strong continuous current in the transmitter. Campbell himself was not satisfied with his results, for he declared that after the experiments he found it odd that the microphone could be capable of reproducing human speech in its fine shades.

Campbell's researches had the cardinal error of taking the voltage measured at the terminals of the induction coils as a measure of the action of sound. It is a well known fact that the current generated in the secondary circuit is not determined by a single quantity. In the case of these measurements the impedance of the circuit was composed of the induction coil and the electrostatic voltmeter. By the insertion of different condensers we can change at pleasure the total impedance

1Abstract of paper presented at the International Conference of European Telephone and Telegraph Administrations, Paris, September, 1910.

2Chief Engineer of Telegraphs, Budapest.

of the circuit, and thus the current and the voltage. It may happen that for a certain pitch the circuit becomes resonant, while the same circuit will not oscillate at a less or greater number of periods per second. Thus we have really reproduced not merely the curve of sound, but have included in our measurements values dependent upon characteristics of the circuit. In consequence of this the measurements are entirely misleading, since we have determined the relation between the circuit and the frequency instead of the relation between the number of oscillations of the source of sound and the action of the transmitter.

We may avoid this error in a very simple manner by taking for each sound considered only the strongest current which is produced in the circuit. For each particular sound there are put in the circuit as many condensers as is necessary to obtain resonance. In the case of resonance the intensity of the current depends not merely on the intensity of the source of sound, but also on its uniformity and on the action of the transmitter, and thus the current, found at the time of obtaining the electric resonance, is in effect the factor measuring the action of the transmitter.

In this manner I have determined the curves of the transmitters reproduced in Fig. 1. The numbers of oscillations of the sound wave have been plotted as abscissas and the ordinates are the values of the intensity of current measured with the barretter in the secondary circuit with electrical resonance, in microamperes. The transmitters are of Hungarian manufacture, and, as may be seen, of different values. An artificial line was also inserted in the circuit as shown in Fig. 2. The characteristics of the artificial line (resistance, self-inductance, capacity) were such that the artificial line corresponded to an effective impedance of nearly 4,700 ohms. To make this better understood, I might observe that the total impedance in a circuit of 700 kilometers, consisting of copper wire four millimeters in diameter, mounted on double supports, is 3,330 ohms, and that of 800 kilometers 5,070 ohms.

The differences shown between the transmitters examined has involved me in the most minute search of the cause of the variations. It seems probable that by selection one might succeed in finding those which give a current stronger and more nearly alike, so that transmitters of a superior order might be constructed. In applying the principle of selection to transmitters, I have found that the transmitters of a common battery lend themselves best to development. While the fundamental tones of the transmitters of other systems were lower (about 600), the natural frequency of the C. B. (common battery) is about 800. Considering that the number of oscillations of the ordinary vowel *a* exceeds 900 (its harmonic oscillations are, of course, of higher frequency), it is of prime importance to consider that transmitter the best which, by reason of this high fundamental tone, is capable of giving the higher tones in a manner which more nearly conforms with reality. In consequence of the effect of capacity and conductivity, the higher tones are more damped in their course through the conductor, and hence it is desired that the transmitter should make the higher tones of speech proportionately stronger than the lower tones.

The results obtained in the researches on the C. B. transmitters show that the voltage of the battery can be considerably increased above all those of American construction, without the transmitter heating perceptibly.

It is found from the pursuit of the present researches that advances are possible by the elevation of the fundamental tone of the transmitter and by the employment of a construction permitting high-voltage batteries, and consequently avoiding heating, even with a very strong current. As for the necessity of the elevation of fundamental tone, I had already discovered that in 1906. It is true that many difficulties were met with in carrying it out. The question has been satisfactorily solved by the engineers, Egner and Holmström, whose transmitter is shown in Fig. 3. The diaphragm is quite large, and tightly stretched by the tension mechanism shown, by which the fundamental tone of the diaphragm of the transmitter can be raised. In the speech heard with the use of such a transmitter the highest tones remain, in a long circuit, strong enough to be understood, and with the aid of such a transmitter one can speak better and at longer distances than with the transmitter previously employed. As the principle of tension as such, being generally known, cannot be patented, the inventors concerned themselves with the theory of the points of junction with the diaphragm, and have under this title acquired a patent. As may be seen from the design, the cooling of the transmitter should be very good. The inventors claim to operate the transmitter with one ampere, and this heavy current assists in obtaining the excellent results. According to their statement, Egner and Holmström have operated over a distance of 3,189 kilometers with a copper wire 4.5 millimeters in diameter.

At present there are employed in the world more than 5,000,000 transmitters, and if the development goes on rapidly this number will reach, in a few years, probably even before the general use of the Egner-Holmström transmitter, as high as 10,000,000. It is desirable that the transmitters already existing can be remade in such a manner that they will stand a current of one or more amperes, and they thus may be employed in long-distance telephony. The remodeling has been done in a very simple manner, that is, with the application of cooling, which lends itself well enough to telephony at a distance of 2,500 kilometers on a copper wire four millimeters in diameter, not merely on a quiet circuit in good condition, but with wires which are shaking or disturbed.

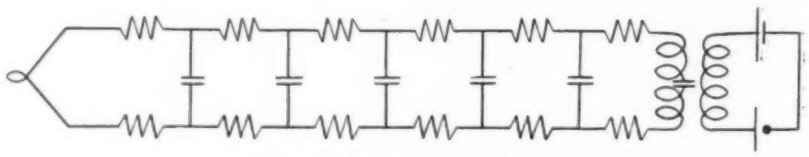


FIG. 2.—DIAGRAM OF CIRCUIT.

I wish here to express my thanks to André Kolossvary, chief technical director of posts and telegraphs, who lent an indefatigable zeal to enthuse me in my moments of discouragement and to encourage the carrying out of this useful work. The tests on the subject of a distance limit are not yet terminated, and I have confidence in the possibility of telephoning as far as

3,000 kilometers, using a four-millimeter copper wire. One might, perhaps, be astonished to find that after having gone from 1,000 to 2,500 kilometers, the addition of the 500 kilometers necessary to make the 3,000 would not be done in as easy a manner. It is a human quality that we like to figure such relations as a straight line when very often they are not rectilinear, but logarithmic. Unfortunately, in the practice of long-distance telephony it has been established by Pupin that the product of the length of the circuit and the damping cannot surpass 2.5 to 3. Thus, for example, with damping of a value of 0.003, and the employment of our present transmitters, it might be possible to speak over 1,000 kilometers. At less distances, up to 1,000 kilometers, the product obtained by the length and the damping gives a value which accords very well; at longer

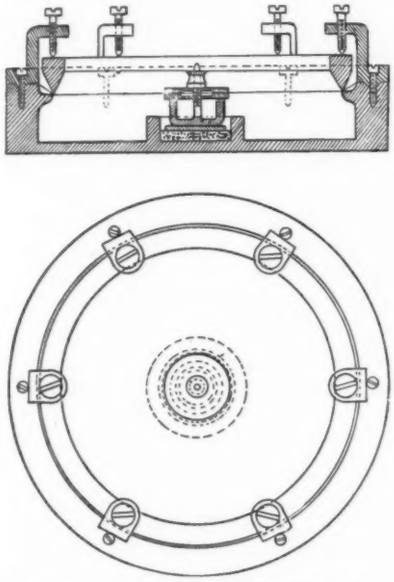


FIG. 3.—EGNER-HOLMSTROEM LONG-DISTANCE TRANSMITTER.

distances, the result is decidedly absurd. To better elucidate this, I will go a little into the theory of long-distance telephony. According to Kennelly the intensity of the current should, with the apparatus now in use, give in the receiver about 1,000 microamperes, in order that speech may be comprehensible. The intensity of the receiving current is given by the equation

$$i = \frac{e}{Z_1} \qquad (1)$$

where e is the tension applied at the terminals of the secondary spools; and Z_1 is the equivalent total resistance of the circuit.

$$Z_1 = Z_0 \; sinh \; (L^a) + Z_r \; cosh \; (L^a) \qquad (2)$$

where *sinh* and *cosh* signify the hyperbolic sine and the hyperbolic cosine.

$$Z_0 = \sqrt{\frac{r + ipl}{g + ipc}} \qquad (3)$$

$$a = \sqrt{(r + ipl)\;(g + ipc)} \qquad (4)$$

where r, l, c, g are the effective resistance per kilometer, the self-induction, the capacity and the leakage conductance; L is the length, p is 2π times the frequency, Z the total resistance of the receiving apparatus.

$$i = \sqrt{-1}$$

$$Z_r = r_r + ipl_r$$

When the value L^a has passed 2.5,

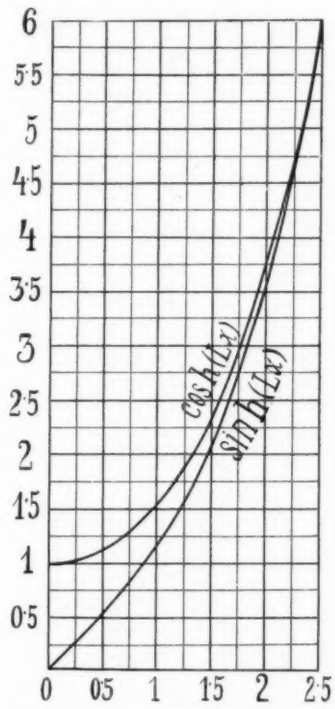


FIG. 4.—VALUES OF HYPERBOLIC SINE AND COSINE.

then, as shown in Fig. 4, *sinh* (L^a) and *cosh* (L^a) have nearly equal values; *sinh* 2.5 = 6.05 and *cosh* 2.5 = 6.13; in this case we may write *sinh* instead of *cosh*, which simplifies the expression for Z_1.

$$Z_1 = Z_0 \; sinh \; (L^a) + Z_r \; sinh \; (L^a),$$

or

$$Z_1 = (Z_0 + Z_r) \; sinh \; (L^a) \qquad (5)$$

It is seen from formulas (1) and (5) that the incoming current varies with the resistance and consequently with *sinh* (L^a), and only where little values are concerned is it permissible to use, instead of the expression *sinh* (L^a), simply the product, L^a.

In Table I are presented numerical values, which are shown in Fig. 5. With a large value of L^a the error may be

TABLE I.

$a\,L$	sinh (aL)	cosh (aL)
0.5	0.52100	1.12763
1.0	1.17520	1.54308
1.5	2.12928	2.35241
2.0	3.62686	3.76220
2.5	6.05020	6.13229
3.0	10.0179	10.0677
3.5	16.5426	16.5728
4.0	27.2899	27.3082
4.5	45.0030	45.0141
5.0	74.2032	74.2099
5.5	122.3439	122.3480
6.0	201.7132	201.716
6.5	332.5702	332.572
7.0	548.316	548.317
7.5	904.021	904.021
8.0	1490.479	1490.479

enormous, thus for $L^a = 8$, *sinh* $(L^a) = 1{,}490$, which means that by increasing the resistance we may make an error of about 20,000 per cent. Of course

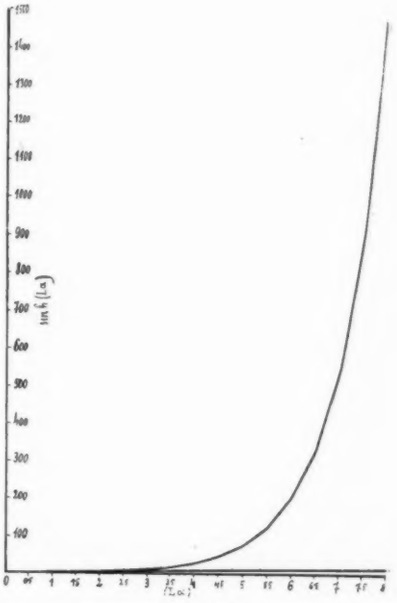


FIG. 5.—SHOWING RAPID INCREASE IN HYPERBOLIC SINE.

this is inadmissable, but it shows why the procedure should be avoided.

Fig. 6 and Table II show the total resistance of the circuits constructed of copper wire of different diameters and different lengths. Returning to the case of a four-millimeter copper-wire circuit, we see that up to 1,000 kilometers, in a circuit without terminal apparatus, that is to say, where $Z_1 = O$, the resistance to be overcome is 11,768 ohms; we shall have at 2,000 kilometers in the same circumstances to overcome a resistance of 801,390 ohms,

and at 2,500 kilometers 6,522,000 ohms. The increase from 1,000 kilometers to 2,000 kilometers does not signify doubling the resistance, but sixty-eight times as much.

To avoid disturbances, the four-millimeter wires of our Hungarian circuit are at a distance of 212 millimeters from each other, and consequently their self-induction is by comparison with the long foreign circuits proportionately less and their capacity proportionately greater. In calculating the 4.5-millimeter circuit which is in use in our country, on the basis of the foreign arrangement the result for the circuit resistance of the 4,000-kilometer circuit is 33,875,000 ohms. I mention that in the telephone experiments at 2,500 kilometers the Budapest cables, with a length of thirty kilometers, have been included; if we compute the resistance of this thirty-kilometer cable and include it in our figures we find that telephony at 2,500 kilometers surpasses the record of the world (4,000 kilometers in a foreign circuit of 4.5 millimeters), and thus the transmitter constructed by the experimental station might be considered as sending over the longest-distance circuit in the world.

TABLE II.
RESISTANCE OF LINES OF DIFFERENT LENGTHS.

$p = 10^4$	Diameter of Wire in Millimeters			
	3.0	4.0	4.5	5.0
Γ	5.	2.8	2.2	1.7
$10^2\, l$	1.49	1.43	1.58	1.56
$10^n\, c$	11.00	12.00	10.27	10.47
$10^n\, g$	1.	1.	1.	1.
$10^3\, x$	41.58	41.28	40.48	40.53
Z_o				

Length in Kilometers	Value of $Z_o \sinh (L\alpha)$ in Ohms			
	3.0	4.0	4.5	5.0
100	418	318		
200	787	453		
300	1474	568		
400	2972	950		
500	5930	1447		
1000	185720	11768	4009	1024
2000	182160000	801390	81801	
2500		6522800		
3000			1665351	11378
4000			33875725	

As can be seen from the formula (1) the resistance of the receiver is not included in the curves; in the 2,500-kilometer trials the impedance of the receiver employed, Z_1, was about 1,000 ohms, that is to say, $3 \sim Z_o$, and they have succeeded in overcoming with the aid of the Hungarian transmitter nearly 20,000,000 ohms. In taking a smaller value for the resistance of the receiver or the coil ratio, or a greater value of c, we can hope to conquer yet longer distances, and I have confidence that telephony will be possible at 3,000 kilometers even with a four-millimeter conductor. The distance between Constantinople and London is nearly this great, and thus telephony across Europe will not be counted among the impossible things.

Census Report on Poles.

The total number of poles reported to the Bureau of the Census as purchased during the calendar year 1909 by the telegraph and telephone companies, steam and electric railroads, and electric light and power companies of the United States was 3,739,000, as against 3,249,000 in 1908 and 3,283,000 in 1907. There were purchased in 1909 by the same class of users 3,509,000 cross-arms, 6,168,000 brackets, and 18,463,000 insulator pins. Cross-arms, brackets, and insulator pins were not included in the annual census of lumber and timber products prior to 1909.

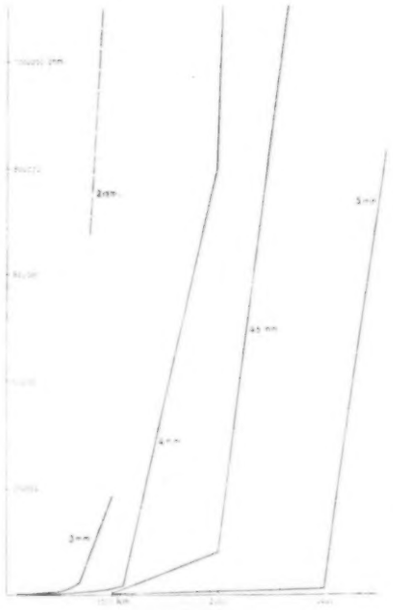


FIG. 6.

Telephone and telegraph companies reported purchases during 1909 of 2,916,000 poles, or 78 per cent of the total. This was an increase over 1908 in the number reported as bought by this class of users of 354,000 poles, or 14 per cent, and over 1907 of 604,000 poles, or 26 per cent. Steam railroads reported the purchase of 26 per cent more poles in 1909 than in 1908, though 34 per cent less than in 1907, while the reported purchases by electric railroads and electric light and power companies were 18 per cent greater than in 1908 and 7 per cent less than in 1907.

SUMMARY OF POLES PURCHASED.

Kinds of Wood.	1909. Number.	1909. Cost.	1908 Number.	1908 Cost.
Total	3,739,000	$7,074,000	3,249,000	$5,929,000
Cedar	2,440,000	4,680,000	2,200,000	3,781,000
Chestnut	608,000	1,383,000	516,000	1,227,000
Oak	237,000	137,000	161,000	95,000
Pine	180,000	520,000	117,000	383,000
Cypress	78,000	117,000	91,000	148,000
Juniper	44,000	79,000	42,000	83,000
Tamarack	30,000	18,000	24,000	32,000
Douglas fir	25,000	35,000	20,000	30,000
Redwood	23,000	49,000	13,000	39,000
Bois d'Arc	21,000	9,000	18,000	11,000
Spruce	11,000	18,000	8,000	23,000
Locust	10,000	9,000	10,000	8,000
All other	32,000	19,000	29,000	18,000

There was little change in the average cost per pole of all lengths and from all species of wood in 1909, as compared with 1908, it being $1.89 in the later and $1.82 in the earlier year.

Substantial progress in the practice of treating poles with chemicals to preserve them from decay is disclosed by the returns for 1909, nearly one-sixth of the total purchases during the year having been given some preservative treatment, as against about one-tenth in 1908.

The comparative summary is given in the table.

French Wireless Experiments.

In recent wireless telephone experiments which were carried on between the battleships Verite and Justice of the French Republic, communication was carried on at a distance of sixty-nine miles.

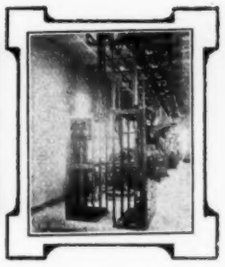
Some trials with interference were made, and it was found that even with other stations setting up violent disturbances communication could be carried on over a distance of eighteen miles.

Minnesota Independent Telephone Association.

Plans for the program of the annual convention of the Minnesota Independent Telephone Association to be held in Minneapolis early in 1911 are in the hands of the following members of the executive board: L. F. Clark, Bellingham; W. S. Clay, Hutchinson; W. B. Carman, Detroit; P. M. Ferguson, Mankata, and George Ocobock, Norwood.

The Hydro-Electric Commission of Ontario is considering the sale of power to Detroit, Mich., as the demand on the Canadian side does not equal the supply.

Industrial Power



ELECTRICITY ON GERMAN FARMS.

MACHINERY VS. LABORERS.

While the United States has led the world in pioneering many classes of electrical development (such as the successful making of arc lamps, incandescent lamps, telephone and electric railways), it is not doing so when it comes to utilizing electric power in agriculture. Here and there we find progressive farmers equipping their houses and barns with both electric light and power, but when it comes to utilizing the current out in the open fields, this country is far behind Germany. The reason for it is a threefold one, lying partly in the smaller size of the average German farm which makes it more accessible for intensive cultivation. Another reason is the nearness to the average German farm of some town having an electric light plant from which the current can be purchased without requiring the farmer to install a generating plant of his own. The third reason is that the labor problem seems to have become even more serious in Germany than in some parts of our own country.

Aside from the saving in the cost of planting, tilling and harvesting the crops, the use of machinery on the farm partly solves the difficulty of procuring farm helpers, who have been steadily growing more scarce in Germany. The reason for this scarcity of farm labor is not far to seek, for statistics show that while the population of Germany has increased about fifty-eight per cent during the last thirty years, the exodus from the rural districts to the large cities of Germany and to America has left the number of farm workers even smaller than it was thirty years ago. Of course the demand for farm products has grown with the population and fortunately the more modern methods of sowing and cultivating have increased the productivity of the soil so that the German farmers can hold their own with the increased demand for crops, provided that they can procure the needed power either from laborers or from machinery. Thus government statistics show that the present methods, as already adopted in Germany, have increased the productiveness per acre seventy-five per cent for potatoes, sixty-three per cent for rye and fifty-two per cent for wheat, making an average gain ahead of the increase in population during the last thirty years. Raising and harvesting these larger crops has required a large number of foreign farm helpers, the number thus employed during 1908 being over 314,000. While these foreigners are only paid about two marks per day (47 cents) and their keep, they are frugal and their savings are usually sent out of the country; hence the government is encouraging the use of any machinery or equipment that will reduce the needed number of such imported farm helpers.

ELECTRIC FARM MACHINERY.

The indoor electric devices used on the up-to-date German farms differ but little from those with which our more progressive readers are familiar, comprising food choppers, grain cleaners, milking machines, pumps, cream separators and the like. But in addition to these, the accessibility of overhead wires has led to the successful use of electrically driven field machinery, much of which is new to American practice. Incidentally, it is threatening to crowd out the costliest of our outdoor implements, the steam-driven threshing machine. This can not safely be used indoors as the sparks from the furnace or smokestack would make too serious a fire risk; indeed, the German insurance regulations require such a steam "locomobile" to be kept at least thirty-two feet from the barn. The fire risk can easily be made a negligible one with a properly installed electric thresher which can be placed indoors so as to be used on rainy days, and as there is no delay in firing up, the available helpers can utilize it the moment the rain starts. The greater uniformity of speed of the electrical driving also increases the output of the thresher in salable grain over that obtained by steam or horsepower, the difference being from three to ten per cent over these and from fifteen to twenty per cent over the flail (hand) threshing.

Another novel piece of equipment is the electric plow, a worthy successor to the steam plows of which over three thousand are already in use in Germany. The steam plow has the advantage of being a self-propeller while its electric rival has to be drawn to the field. However, the latter weighs fully a third less than the steam plow and hence does not pack the soil so tightly. It requires no hauling of water or fuel; can be drawn over roads, bridges and fields for which the steam plow would be too heavy, and requires neither a skilled attendant nor frequent cleaning and repairs. Moreover it can be used on hillsides where the tilting of the steam plow would tip one edge of the firebox clear of the water, thus encouraging explosions. The electric plow usually consists of a double-ended plow mounted on wheels and drawn back and forth across the field by a wire rope attached to an electric motor. The same rope can be fastened to a cultivator or a harrow, thus increasing the utility of the equipment and decreasing the use of horses. The differences in the cost of plowing were recently stated by Harold Wallen (in a lecture before the German Electrotechnical Society at Brannschweig) to be as follows:

	Per hour.	Per acre.
Horse-Drawn Plow	$2.60	$1.30
Steam Plow	3.28	1.64
Duplex Electric Plow	2.36	1.18
Simple Electric Plow	2.10	1.05

Still another labor and horse saver that is being tried with success in

Germany is a private trolley road for transporting the crops from fields to barns and from the latter to the nearest railroad point, as also for hauling the fertilizer and seed. Such railways are usually of narrow gauge similar to the so-called industrial railways used in and around large manufacturing plants and are sometimes augmented by portable sections of track for extending the road to different portions of the field. In one instance it was found that with a farm of 2,000 acres located two miles from the nearest railroad, the installation of electric plows and of a narrow gauge trolley line did away with thirty-one out of forty-seven horses and also with fifteen men. The increased speed of hauling the crops is an important factor in making such a railway pay for itself and the same holds true of electric hay loaders and electric fodder hoists as already used to a limited extent.

Of course the use of such labor and horse-saving electrical devices assumes the nearness of electric power circuits, which is a condition much more commonly found in Germany than in the United States. However, the spread of electric light wiring from central stations through and into farming localities is already showing rapid progress in this country and the next few years ought to show some interesting tests of similar electrical appliances in this country.

Electrification of Salt Works.

One of the most recent interesting applications of electricity to industries is to be found in the recent equipment at the Clarence Salt Works of the Salt Union, Ltd., of Middlesborough, Eng. The work involved the changing over from steam to electric drive of the brine pumps, an operation which required a certain amount of experiment, as the power used in this process is somewhat indeterminable. The work also included the erection of a considerable amount of overhead cable transmission and interior wiring.

As brine is known to be a good conductor of electricity, a considerable amount of care had to be exercised in completing this installation. Power is supplied from the mains of Cleveland & Durham Electric Power Company at a pressure of 440 volts between each of the three phases, at a frequency of forty cycles per second.

ELECTRIC POWER IN COTTON MANUFACTURE.

BY C. J. H. WOODBURY.

The process of manufacturing cotton into cloth has always been one of the highly-developed manufacturing methods of its time, ever since the advent of machinery sufficient to convert the cotton lint into finished goods solely by machinery and without the intervention of hand processes.

The supplanting of the prehistoric hand spinning and weaving of cotton is one of the more recent lines of manufacture pertaining to a domestic product, being established in 1816, although it must not be overlooked that power was used in part for the production of cotton cloth at least a century earlier.

The reason of the relatively high grade of the machinery from the first was undoubtedly based on the fact that the cost of the raw material bears a greater proportion to the value of the finished product than any other line of textile manufacture, and perhaps of any other article of manufacture.

It is a ruthlessly competitive business, and during late years, commercial conditions have primarily forced the cheapening of the costs of the manufacture, rather than to seek the development of novelties in the product.

The greater proportion of cotton goods are in standard lines of plain weaves known for generations. The novelties are largely adaptations of designs first commending themselves to public taste through other fabrics, or indeed other repetitions of history, especially through a renaissance of patterns of hand-made fabrics woven in other fabrics during the middle ages.

Cotton manufacturing is essentially a mechanical, rather than an artistic, process in which competition has forced every cotton manufacturer to seek and to adopt each improvement as soon as its economic merit has been established.

The constant changes causing the ruthless demolition of operating machinery into old junk, and installing new machinery which meets a like fate in a short time, shows that the iconoclasm of subsequent invention is far more destructive than the wear and tear upon these high-speed machines.

Mills built by able millwrights of the last generation, became storehouses while strong and sound, or were torn down as cumberers of the ground, to make way for mills designed by engineers who produced buildings which would the more economically serve the purpose.

The general line of these changes in machinery is to supply means by which production would be more rapid and more uniform, and what is of greater importance that its operation should be the more nearly automatic thereby reducing both the amount of labor and the skill required for the supervision of the machines.

Old cotton manufacturing districts in this country also witnessed constant changes in the classes of labor for many of the processes which have been as radical as the changes in the machines. First, the well-educated native American operatives have been supplanted by emigrants of lower grades of intelligence and skill, each in turn giving way for the advent of others, leaving them free to apply themselves to those processes requiring greater skill either in cotton manufacture or elsewhere.

In these many changes in cotton manufacture there has always been one impediment to the true function of a mill until the advent of the application of electricity in solution of the problem.

In all the mills the source of power wheel fixed the site of the mill near to the water wheels at first, however disadvantageous in other respects, or later the steam engine imposed other positive although less exacting conditions of location, yet in all of these, the transmission of power from the prime mover required belts and shafting enclosed in a belt tower, a portion of the plant whose initial cost, maintenance and repairs were excessively expensive.

The transmission of the power by electricity enables a mill to be designed and constructed with a sole intent to the purpose of manufacture. It may be placed on lines of transportation, or convenient to a supply of suitable labor, while the source of power may be a highly economical steam plant, or a distant waterfall which had hitherto flowed unvexed to the sea.

There is one problem which may not yet be solved without exception, and that is, while the economic advantage

of electrical transmission of power has been established in regard to new mills in which it forms a part of the design, yet what is its place in supplanting existing methods of belt transmission.

If the belt plant is taken out, the belt porch remains such an integral part of mill construction that it cannot be removed without impairing the stability of the mill, and therefore, its room cannot be utilized as floor space for machinery.

The changes which have already been made in some instances indicate that some manufacturers have become convinced that they can afford to abandon the belt drives for electricity, even if existing structural conditions do not permit the full measure of advantage which would be obtained in a new mill.

The recent modifications in generator and motor design, especially generators, directly connected to steam engines or steam turbines which have resulted from practical suggestions of mill managers have been of a high degree of usefulness.

The distribution of the power in the mills has given rise to a diversity of opinions upon the relative advantages of the single drives by motors attached to the unit machines, or the group drives applied to shafting as in the former method of receiving the power on each floor from a single source, or more often a modification of the two by dividing the machines into motor-driven groups.

This problem cannot be solved by any consideration of the first cost of the plant, except as capital upon which interest must be earned, in addition to the annual costs of maintenance and depreciation.

It has been found that the production of an electrically-driven mill exceeds that of its belt driven mate, or in other words, it approaches more closely to the theoretical product of the mill, and this is due to the positive character of the speeds as the coils forming portions of circuits in the armatures are pulled around by the attraction of the magnets, while every belt transmission falls short of the theoretical speeds on account of the creep of the belts, not the slip so much, but the difference between the lengths of the belt extended by tension on one side, and the shorter length of the belts on the slack side.

The polish on pulleys resulting from this creep of belts, tell a story which has failed to reach the text books.

Solely from a mechanical standpoint and without any reference whatever to costs, the electrical drive derived from a steam turbine consists entirely of rotary motions without the conversion of reciprocating motions into rotary motion and, therefore, produces a uniformity of speed that is of great, advantage in this manufacture.

In smaller details which contribute to larger results, electricity is widely used in cotton mills in the various safety devices which stop machines whenever a thread breaks, thereby preventing the formation of waste or at best, an imperfect product. It furnishes the signals for the exact stopping and starting of the whole establishment. The telephone from the office to the various overseers permits them to remain at their post of duty a larger proportion of the time than would be otherwise the case and the manager is easily communicated with by the office, when going through the mill. It relieves the establishment of unproductive messenger boys and furnishes a means for various types of fire alarms and other signals which are of value in every manufacturing establishment.

Much interest is expressed in the final result of electrical drives giving a variable speed to spinning frames according to the angle of the yarn through the traveler, which is fixed by the variable amount of the yarn wound around the bobbin. By thus availing of the opportunity, the spindles can be run at a maximum speed according to the conditions of the moment, instead of the maximum speed of only one condition, and the production of the frame is very materially increased. In many respects the problem is a difficult one, and its final solution will be of great value.

Electrically Equipped Apartment Houses.

There is in course of construction in New York city an apartment building in which electricity will be widely used to provide many conveniences.

Plans filed with the city inspectors show that the conveniences installed include an electric grill for the building and that each apartment will be equipped with electric dishwashers, electric ranges, washing machines, irons and clothes dryers, besides an electric garbage incinerator and an electric refrigerating plant.

Iron and Steel by Electric Process.

A recent consular report states that experiments to produce iron and steel from Norwegian ores by the electric process have been made during the last three or four years, partly by aid from the Government, in response to a petition sent to the Department of Commerce and Industies by the Christiana Polytechnical Society. Private interest has in this manner been awakened, and the industry now promises to become one of considerable importance. The Norwegian iron ore is often so poor that smelting by the old process was found profitless.

The owners of a mill at Tinfos, in Notodden, Telemarken, Norway, have for some time been making experiments for the purpose of producing iron by melting iron ore by the use of electricity as the source of heat. The works were completed in February last, and there has already been an output of 250 tons of iron. The ore used has been mined partly at Lango, near Kragero, and partly at Klodeberg, near Arendal. The melting was accomplished by the use of an electric furnace of about 500 horsepower. This is the first iron produced by the new process, and in commemoration of the event there has been cast and sent to the Christiania University an ingot of the metal weighing 60 kilos and provided with an appropriate inscription.

A stock company, styled the Hardanger Electric Iron and Steel Works, is at present being organized. The capital stock is to be $294,800, of which there has already been sold $160,800. There are 4,400 shares of $67 each. The works are to be located at Ullensvang, in Hardanger, on the west coast, and the object is to produce iron and steel from Norwegian ores by a patented electric process of Swedish origin. The company has secured electric energy from the adjoining water power at Tysse, for a period of thirty years, at a cost of $8.04 per horsepower; 4,200 horsepower will be required. The ore to be used is to be bought from mines in other districts on the best obtainable terms. The transportation of the ore will be found expensive, but it is believed that this drawback will be offset by the cheap power and excellent harbor facilities at the place.

BOOK REVIEWS.

"The Watt-hour Meter." By Wm. M. Shepard and Allen G. Jones, San Francisco: Technical Publishing Company. Cloth, 184 pages (8½ x 5¼ inches), with 117 illustrations. Supplied by Electrical Review Publishing Company for $2.00.

As there is by no means too much known about the ordinary electric house meter, any book that treats of it in a fairly readable manner is bound to be welcome. The book under consideration is therefore doubly welcome because it handles the subject in a clear, simple and yet quite complete fashion, so that an excellent idea of the construction, use, care and testing of the principal types of watt-hour meters may be obtained. After a general introduction dealing with the importance of the meter in the electrical industry, the selection of meters, their general construction and how this affects their accuracy, a brief chapter is devoted to the measurement of power in direct-current and alternating-current circuits. A good description is given of the three principal types of meters: the induction type, commutation type and mercury flotation type, each being fully explained in principle and illustrated by several of the best known makes. Prepayment and maximum-demand meters are also described. In each type of meters the construction, connection and operation are considered in all the more practical details. Maintenance and testing of meters is discussed at some length, over one-fourth of the book being devoted to the standard and special tests, constants and testing formulas, methods of recording readings, and other features connected with keeping the meters in proper order and free from trouble. A concluding chapter takes up the subject of rates, showing briefly why complex rate systems are necessary and also giving as representative schedules of rates those in use in Chicago, Boston, Birmingham and San Francisco. An appendix gives a good set of definitions of electrical terms, determination of temperature rise by resistance method, and adjustment of meters used with instrument transformers.

"Continuous-Current Machine Design." By William Cramp, New York: D. Van Nostrand Company. Cloth, 240 pages (5½ x 8½ inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.50.

This book is intended as a text book for the rather advanced students and in the treatment of the various subjects the author omits the fundamentals which are supposed to be known. The work may be said to be divided into three general sections, the first section dealing with actual theory of direct-current machine design. The second section is devoted to examples of procedure in design, the object of these examples being to illustrate the bearing of the many considerations discussed in the first section. The third section contains the mathematical formula for the theories advanced in the opening chapters. By segregating the mathematics in this manner, where all equasions may be conveniently referred to, the text presents a much neater appearance and is more easily followed by the student. Both in the text and in the examples of procedure the author lays stress upon the tentative and experimental nature of the subject, as also upon the number of variables involved, the ever-present influence of cost, and the careful comparisons that should be carried out before any design is diagrams.

"How to Read Telephone Circuit Diagrams." By David S. Hulfish, Chicago: Electricity Magazine Corporation. Cloth, 257 pages (5 by 7½ inches), illustrated. Supplied by the Electrical Review Publishing Company for $1.50.

This book explains in a simple and concise manner how to read circuits from blue-prints, etc. It comprises twenty-seven lessons, each a complete unit and devoted to the various apparatus which goes to make up a telephone system. The book contains a large number of typical telephone circuits which are fully explained and directions given how to trace all currents. Practically all symbols encountered in telephone disgrams are explained. The text is written in non-technical language to as large an extent as possible, and should be a great help to those desiring to learn how to read circuit diagram.

"Compendium of Applied Electricity." By Paul E. Lowe, Philadelphia: David McKay. Cloth, 342 pages (2½ x 5½ inches), illustrated. Supplied by the Electrical Review Publishing Company for 25 cents.

In this vest-pocket book the development of our electrical knowledge is treated and the practical side of electrical work covering electromagnetic machinery is briefly considered. The chapter dealing with electric railways is quite well covered and should be of especial value to motormen or those who have had only practical training in electrical matters. A dictionary of electrical terms is included in the publication. The book is well illustrated and contains a number of wiring diagrams.

"Elementary Telegraphy." By H. W. Pendry. London, Eng., The Macmillan Company. Cloth, 216 pages (5 x 7½ inches) illustrated. Supplied by the Electrical Review Publishing Company for $1.

This book, which is for elementary students, and for those who have done practical work and desire to know something of the underlying principles of the telegrah, is based on the experience of the author and treats the subject in a practical manner. The battery, instruments, lines and systems as a whole are covered and fundamental theories are well demonstrated. In order that the student may better classify his knowledge, a list of questions and problems follow each chapter.

Central-Station Insurance.

At the St. Louis meeting of the National Electric Light Association, statistics were presented by W. H. Blood, Jr., insurance expert of the Association, tending to show that fire-insurance premiums paid by the electric lighting companies of the country are fully twice as high as the low ratio of loss would warrant. Resolutions were adopted by the Association asking for an investigation of the subject by the fire insurance companies and directing that copies of the resolution be furnished to member operating companies so that they might take up the matter with their brokers. A thorough campaign along these lines has recently been organized as fitting at this season of the year, and large numbers of copies of the resolution have been placed in the hands of the operating companies, requesting them to bring the matter to the attention of their insurance brokers. Letters have also been written from Association headquarters to some two hundred and fifty insurance companies calling their attention to the matter and inviting them to investigate the subject with a view to a reduction in rates commensurate with the premiums received and the risks involved. An extremely interesting report and analysis of the subject generally was presented at St. Louis by Mr. Blood and has been reprinted in the proceedings of the Association.

New Electrical and Mechanical Apparatus and Appliances.

A New Line of Branch Exchange Switchboards.

Today practically every modern hotel, apartment house, hospital, club and business establishment has a private system of communication. Some idea of how this branch of the telephone business is growing can be had by comparing the increase in the City of New York. In 1900, New York City had a total of 1,050 private branch exchange switchboards, with a total of 12,650 stations, while in 1910 this number had grown to 11,960 switchboards, with 162,560 stations.

NEW PRIVATE BRANCH EXCHANGE BOARD.

To meet this rapidly growing demand, the Western Electric Company has placed on the market a complete line of private-branch switchboards consisting of over thirty different types, and now has a board for every condition met with in this service.

This line of switchboards embraces both single and double-position desk and cabinet patterns, in capacities ranging from 60 to 600 lines. Two general types are offered, namely, those employing lamp line signals and those employing magnetic line signals. While both of these types are supplied, the general demand seems to indicate that the lamp-signal board is becoming more popular each year.

One of the features of this lamp-signal equipment is the plug-ended trunk circuits. Ordinarily these trunk circuits terminate at the main exchange on the regular subscriber's line equipment and at the private branch exchange in cords and plugs. The trunk circuits in Western Electric branch-exchange switchboards are wired in such a manner that connections may be made either with common battery or magneto main office. Some advantages of this trunk circuit claimed by the manufacturers are: Fewer cord circuits, forty-eight volt transmission possible, incoming calls from main office completed directly, increased transmission efficiency because trunk is plug ended, individual line can be established to main office without interfering with other circuits on the board, and trunk circuit can be arranged as charging trunk when specified.

All subscriber lines and trunks are terminated in a connecting rack, which in the cabinet type of sections is located directly under the roof. The roof is provided with a piano-type hinge, which allows it to be raised as shown in the cut, rendering the connecting rack readily accessible. In the desk-type switchboards the connecting rack is located in the rear of the desk, so that by removing one of the panels it is easily reached. The connecting rack is equipped with screw terminals, which permits the attachment of line wires without the use of any tool other than a screw-driver. This feature, together with the special guides which are provided, permits the exchange line to be brought in either as braided-rubber wire or as switchboard cable, and in either case it presents a neat appearance.

The circuits of these branch boards are arranged so that they may be operated by current supplied by means of a battery of dry cells from a local telephone central office, or by its own isolated power plant.

Fan Motors for Winter Use.

It is the popular opinion that the range of usefulness of the electric fan motor is limited to the summer months and that its sole utility lies in its application as a means of reducing the temperature of a room or an office. This is not true, however, and slowly but surely the public is beginning to understand that the usefulness of the fan motor is by no means confined to the hot days of summer, and that paradoxical as it may seem the electric fan blows hot and cold; and incidentally while it is blowing hot it cuts the fuel bill.

Following are a few of the more important applications of the fan motor to winter use: The efficiency of the hot-air heating system may be greatly increased by placing a fan motor in the cold-air box to force the air through the registers to all parts of the house. On particularly cold days when the wind

is so strong that it forces the air through the furnace into the rooms without having become heated, a fan motor placed in the cold-air box, after having closed the slide which permits air to come in from the outside and opening the slide which lets the air in from the cellar, will cause an appreciable rise in the temperature of the room, without making any increase in fuel consumption.

As is very often the case, the house contains a room or rooms which under certain conditions are difficult to heat. This difference can be overcome by placing a fan motor in front of the hot air register or over it in case the register is located in the floor. This plan will prove more efficient if the register and fan motor are covered by a box or hood of some kind which will cause the fan motor to draw air from the pipe only, and not from the room.

In a house heated by hot air or steam, increased radiation of heat and consequently a warmer room may be obtained by placing a fan at the end or back of the radiator.

Another manner in which the fan motor may be used to advantage in winter is to prevent the accumulation of frost on show windows of stores. The air from the fan motor directed against

GOTTSCHALK TRANSMITTER—GUARD ATTACHED.

the glass of the window will keep it practically free from frost. This application of the motor is a boon to merchants who have, heretofore, during the cold weather, lost practically all the advantage which their window display accomplishes.

A new cable is to be laid between Ascension and St. Vincent in the Cape Verde Islands. This cable is 1,775 nautical miles in length, and it is expected to have it ready for working by the end of the year. This cable will be operated by the Western Telegraph Company.

A New Type of Telephone Transmitter.

The accompanying illustrations show a new type of telephone transmitter invented by Felix Gottschalk. 99 John Street, New York, N. Y. This transmitter is constructed upon a very ingenious principle and from the following description it will be seen that it possesses characteristics which should make it a desirable addition to this character of telephone equipment.

The transmitter consists of the usual

SIDE VIEW—GUARD ATTACHED.

shaped casing, in two parts, and a granular carbon resistance cup, with front and rear electrodes of the Western Electric type. The regular diaphragm is replaced by a metallic disc with a step-shaped flange at the periphery. The casing supports a forwardly extending circular rib, externally threaded, on which the diaphragm is tensioned by means of a screw ring internally threaded. The diaphragm is connected with the front electrode of the resistance cup by spider legs, soldered to the diaphragm and attached centrally to a hub, the threaded aperture of which engages the front-electrode stud. The rear electrode has a solid back with the usual bridge connection. The front electrode is in circuit with the casing, and the back electrode is insulated from the bridge by means of a fibre bushing. The flaring mouthpiece of the ordinary type of transmitter is replaced by a foraminous guard covering the entire face of the diaphragm, the sides having a bayonet slot engagement with the casing, and being secured by a screw at the periphery. The lower portion of the side of the guard is open to provide for the circulation of air between the diaphragm and the guard. Damping is accomplished by means of a flexible ring within the circumference of the inner side of the diaphragm and held in place by a flat metal ring secured by the projecting rib. The two sections of the casing are made watertight by means of screws having engagements with the face of the front casing, and connecting with lugs soldered within the wall of the back casing, and a washer interposed between the two sections. An insulating block attached to the bridge is provided with a socket opening to the rear, and the walls of this socket are split and constricted. The aperture in the rear casing is fitted with a tubular boss, externally threaded and protruding beyond the surface. A cup-shaped rubber cap provided with an aperature for the terminal cord fits over this boss. This cap is fitted with a soft rubber gasket, and when it is tightened it forces the tip of the connecting cord into the constricted socket, thus making a good contact, and effectually seals the transmitter against water and atmospheric influence. This forms a new method of connecting the wire tip to the insulated split socket without taking the transmitter apart.

This transmitter was recently given a thorough test for articulation and transmission at the laboratory of the electrical engineering department of the University of Kansas, and a report

TRANSMITTER WITHOUT GUARD.

made by George C. Shaad and C. A. Johnson. The Gottschalk transmitter was compared with a standard transmitter of the Western Electric Company's manufacture, carefully selected with regard to its good transmission properties. Standard common-battery equipment was used with artificial line consisting of coils of wire having a resistance equal to that of fifty miles of No. 9 copper wire, two coils together having the same inductance as fifty miles of No. 9 copper wire. For each fifty miles of line a one-microfarad condenser was bridged across, this ca-

pacity being slightly in excess of fifty miles of line. The total line consisted of fifteen of these sections, and the total length of line used could be varied in fifty-mile steps from zero to 750 miles. A series of words was pronounced into one transmitter, using an ordinary tone of voice, and holding the mouth about two inches in front of the instrument. The second transmitter was then quickly switched into position and a similar test effected. A series of these tests was carried out over lines of different lengths and the results checked by different observers. The results show that for all practical purposes the transmission of the two instruments was the same.

The Gottschalk transmitter was subjected to a freezing atmosphere of ten degrees Fahrenheit and upon being tested as quickly as possible after being removed from the freezing chamber was found to give results practically the same as when at the normal room temperature. The transmitter was then placed in water and gradually brought to a temperature of 150 degrees Fahrenheit and immediately tested. No change in the transmission qualities could be deducted.

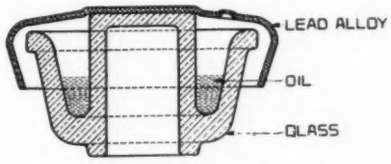
Immediately after the tests of the transmitter at the higher temperature, the instrument was opened and the interior was found to be perfectly dry.

The following advantages are claimed for the Gottschalk transmitter: (1) Elimination of the flaring mouthpiece, thus making it more sanitary, as the flat guard prevents to a large extent the collection of dust, dirt, moisture or germs. (2) With the mouth three inches away from the guard, transmission is not impaired, thus avoiding actual contact of the mouth and any part of the transmitter. (3) The transmitter is effectually sealed against any atmospheric influence, and moisture cannot affect any of the interior parts of the instrument, including the carbon chamber. (4) The waterproof property, together with the fact that all exterior parts are metallic, makes it an ideal transmitter for use where the instrument is much exposed, as in public stations, on railways and in mines. (5) The instrument does not have to be disassembled in any way in order to connect or disconnect it from a wall or desk set. The terminal can be attached and good contact made without taking the casing apart.

Storage-Battery Insulators.

Much trouble has been experienced in properly insulating storage batteries, especially on high-voltage circuits. The ordinary glass insulators give satisfactory results in many cases, but where the circuit is grounded there is a tendency to a leakage of current over the surface of the insulators, especially when the latter have become coated with dust and acid. This leakage sometimes sets up electrolytic action which may eventually corrode through the lining of the tank.

The Electric Storage Battery Company has developed a new type of oil insulator which is described in its bulletin No. 126 recently issued. Previous experiments with oil insulators have not been very satisfactory, but the present design has proved so efficient that it is being used in many new installations, especially where the voltage is higher than 220 volts, or where one side of the circuit is grounded. The design of this insulator is shown



CROSS SECTION OF INSULATOR.

by the cross section given in the accompanying illustration. The glass body is provided with a circular trough which is partially filled with oil and covered by a cap of lead alloy, which is so designed as to exclude spray and other foreign matter from the oil space. It also serves to protect the oil from the effects of splashing when the floor is washed. The lead cap fits as closely as possible over the outer rim of the insulator, but without coming in contact with it, and the upper edge of this rim has a protecting lip to further protect against entrance of moisture. The oil chamber is of sufficient depth to provide for the accumulation of any foreign matter or water which may leak in. While refilling will seldom be necessary, provision has been made for it by a small hole in the cap. The insulator rests on a heavy lead washer in order to distribute the weight more uniformly. Some of these insulators have been in service for a number of years under extreme conditions, and in no case has electrolytic action been noted.

New Electrical Safety Signal Device.

A system of railroad signals, which has many unique and interesting features, has been perfected by a Boston man, F. Leslie Hall, and will be presented to the Interstate Commerce Commission, at its orders, for trial installation on a southern railroad during the winter. Mr. Hall's invention is a combination of the familiar semaphore or block, installed at each station on a division, and a series of torches attached to the telegraph poles between stations. The whole is under the complete control of the train dispatcher, who, by means of a small instrument resembling an alarm clock, automatically controls the semaphores and torches and is able to use the torches instantly if the engineer runs past the semaphores. The wire used for the railroad's telegraph messages carries the current for the signals. At each station the wire is cut in and the "metregraph" is attached. Similarly at each telegraph pole along the line the wire is tapped and a connection established with a box containing the torches used for emergency signals.

Each station on the division is given its number in rotation, and these numbers are shown on a dial of the clock-like apparatus which the train dispatcher has alongside his telegraph instruments. Wishing, for instance, to call the sixth station on the division, he inserts a plug in the numbered hole, releases a spring and immediately the activity at station No. 6 begins. First, a telephone bell rings, and the operator at the station may be given verbal instructions. But immediately following the bell a key in the metregraph swings around and automatically sets the semaphore arm at danger, stopping the progress of an approaching train. Simultaneously with the setting of the block the fact that it is set is recorded, with the exact time on a register on the dispatcher's table at headquarters. He thus has a complete and indisputable record of his actions during the day, which will show to the fraction of a minute the times at which he set the blocks at various parts of his division. Similarly, the time of the release of the block is recorded.

Mr. Hall claims the greatest benefit of his invention may be said to be the emergency torches. Trainmen frequently pass blocks, because, they say, they are encountering them at almost

every mile of the road. They insist that only some sudden signal, sure to attract their attention, will be effective. Mr. Hall, therefore, goes on the assumption that the semaphore will sometimes be disregarded or misunderstood. The moment that the train passes the set semaphore, that fact is automatically recorded in the dispatcher's office. Either he or the operator at the station where the block has been set and disregarded will then simply have to operate a lever.

Immediately the torches between the stations where the train is in danger are released and set on fire, so that for as long a distance as may be desired the track is alight with the warning red fire, and the unheeding engineer as well as the engineer of an oncoming train must inevitably halt their trains.

The torches can be employed for other uses and can be employed at night by train crews in place of the lantern, which at night, under the present system, must be carried back by the rear brakeman to warn trains in the rear. By Mr. Hall's arrangement the station operator has only to release a torch 300 feet down the track in the rear of a train standing in the yard or on a block.

The torches are hung by three feet of chain from the bottom of the signal box and are ignited as they drop by a sulphuric acid vial or cap, broken by the fall of the torch. They burn furiously for fifteen minutes, when another can be dropped. In case of a washout or spreading rails, these torches all drop instantly, as the broken rails make the contact.

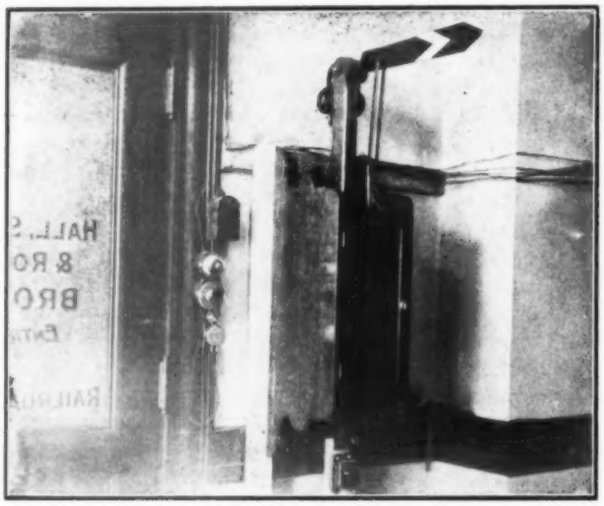
The automatic transmitter employed to operate the selective instruments is so constructed that its action is positive. When the handle that operates the make-and-break wheel is moved away from zero it is locked against any retrograde motion until it strikes the pin that checks its advance. Contact with this pin releases the locking-pawl and the handle will return to its normal position. Should the dispatcher place the pin in the wrong socket, his mistake is immediately called to his attention by the number of the signal being telegraphed back when the semaphore drops to danger.

INTERIOR OF METREGRAPH BOX.

The red lamps, which are automatically lighted on the transmitter dial, serve to show at what stations conductors are to report for orders. At the expiration of the dispatcher's duties for the day, the register tape containing a record of the stations called can be filed away for any necessary reference.

When the semaphore is set at danger at any station, a gong is also started ringing, which notifies the operator or agent that he must immediately report to the train dispatcher for orders, thus obviating the serious delays which occur when they are absent from hearing the telegraph sounder. By providing conductors of trains with keys to the boxes containing the instruments, they may automatically report their trains at stations where there are no telegraph operators or night station agents.

This is done by releasing an automatic transmitter, which sends the number of that station to the train dispatcher. If the train having the right of way is late, the dispatcher can operate a code signal, which will allow the train automatically reported to proceed to the next station. If the train to be met, however, is on time, then the dispatcher will release the semaphore signal and hold the train reported until its arrival. When any telephone station in the division is in operation, all other stations are notified by the display at these stations of the number of the station selected.



SEMAPHORE SET AT DANGER.

TRAIN DISPATCHERS' CONTROL.

Mississippi Valley Telephone Property Sold.

Webster Brothers of Milwaukee, Wis., recently bought the Mississippi Valley Telephone Company for $175,750 at a foreclosure sale. The property was sold to satisfy a bonded indebtedness of $175,000.

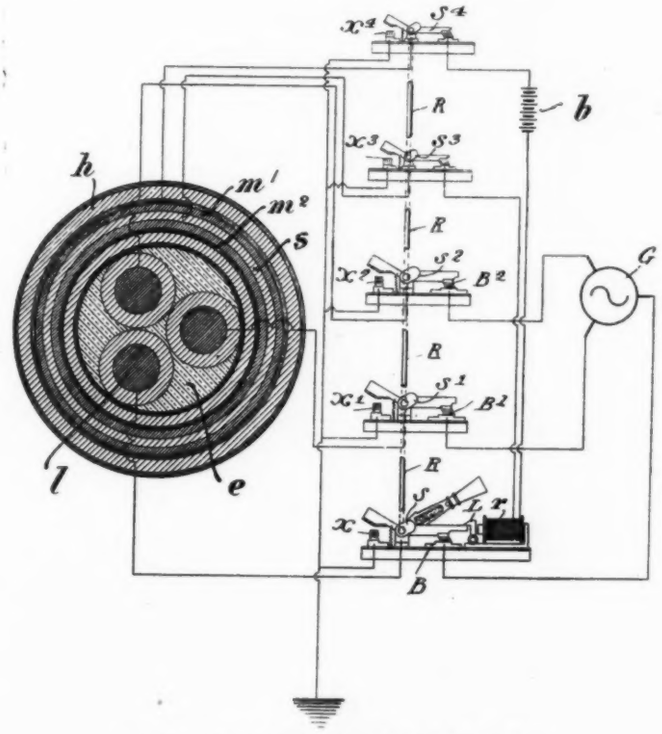
An Electrically Protected Power Cable.

The use of electricity in mines is rapidly extending despite the hazards which it introduces to a greater or less degree. These hazards, it is admitted by all fair-minded men who have looked into the subject, are due to the very rough service to which electrical apparatus is subjected in mines. Although the electrical hazards are in general less dangerous than those existing before the use of electricity, as for instance in the case of electric lighting, nevertheless electrical men are continually striving to reduce them, and fortunately are meeting with excellent success.

A protective appliance along these lines has been invented by Georg Bartels, of Nippes, near Cologne, Germany. A United States patent was recently granted to this inventor on a form of electric cable and the patent assigned by him to the Land und See Kabelwerke Aktiengesellschaft, which has a large cable works in his native city.

This invention has for its object to provide an electric cable so constructed that in the occurrence of any mechanical damage to the cable, such as by squeezing, crushing, twisting, impact, etc., which may be so great as even to destroy the cable to its very core, contact will be made between two auxiliary conductors at an earlier moment than that at which the insulation of the conductor carrying the main current is injured, with the result that a cut-out switch is set in operation, so that no arcing can take place at the point of injury to the cable.

In the accompanying diagram is shown how this idea is applied to a cable carrying a three-phase power current. The cable is shown in cross-section with the main conductors l each independently insulated and also surrounded by a strong and highly elastic electrically insulating material e. Around the whole of the conductors l and material e there are arranged two concentric braided metal casings or windings m^1, m^2 which are separated from each other by a thin layer of pliable material s that is capable of being broken or damaged with comparative ease relatively to the material by which the main current conductors are insulated. A layer h of highly elastic electrically insulating material is laid around the outermost of the auxiliary concentric conductors m^1, m^2.



ELECTRICALLY PROTECTED POWER CABLE.

The two outer auxiliary conductors are arranged in series in a circuit including a low-tension battery b, and an electromagnet r. This magnet when excited attracts the latch L, tripping the switches or cut-outs S, S', S^2, S^3, S^4, all of which are mounted on one shaft R, partly broken portions of which are diagrammatically represented in the drawing, or otherwise connected so as to operate in unison. The effect of the operation of the switches is to open the circuits between the generator G, and the cables l at B, B', B^2 and to ground all the cables l and concentric conductors m^1, m^2, by closing the ground connection at X, X', X^2, X^3 and X^4. Thus the current from the generator is shut off and all parts of the cable are grounded so that no arc can form at the point of rupture or elsewhere in its length.

This idea can also be applied to a submarine or other cable and the lead sheath and an outer steel-wire armor may constitute the auxiliary conductors.

Electric Vehicle Development in St. Louis.

The only exclusive electric-truck garage outside of New York city has been built in St. Louis. When it opens this garage will be the first in the United States to be operated by a public service corporation. An experiment by the Union Electric Light & Power Company with a garage for pleasure electrics was the forerunner of the truck garage. Four years ago there were just eleven electric pleasure automobiles in St. Louis. The electric truck was almost unknown there. A single agent was offering for sale one kind of pleasure electrics. The Union Electric management ventured upon the experiment of a garage for pleasure vehicles, establishing it on Morgan Street, in the West End. Today there are in the city 375 pleasure automobiles of the electric type. Every manufacturer of these automobiles is represented in St. Louis. There are in operation seven garages for electric pleasure cars alone.

Soon after the establishment of that pioneer electric garage, the Union Electric Company began to experiment with electric trucks. The agency for a manufacturer of those trucks was taken and some were sold the first year. During three years a careful record has been kept on the cost and effi-

ciency of electric trucks for the hauling of merchandise. Comparison has been made with horse service for like purposes. The results of the three years' trial demonstrates saving of time and expense to such an extent that this garage for electric truck service has been built and equipped at large expense.

There are now in service 150 electric trucks, with increasing demand for this kind of service, which seems to justify this garage measuring 75 feet front by 175 feet depth and 40 feet height. The location is Twentieth and Locust Streets, adjacent to ninety per cent of the merchandise hauling of the city and within a mile and a half of every freight depot of St. Louis.

In several respects this electric-truck garage is notable. There is not a column in the whole interior. The switchboard and rheostats are of the latest types. The first set of charging plugs is along the walls. The second set is dropped from the steel roof girders with a device by which the plugs can be elevated out of the way when not in use.

At the east end of the great hall is a spacious, well ventilated battery room equipped with the most improved lead burners' devices. These are very important features of a garage, insuring economy to the truck owner. A store room and a machine shop will be maintained with all the necessary machinery.

The establishment of the electric-truck garage marks an important addition to automobile business in St. Louis. Foreseeing the certain expansion of the field, the Union Electric will maintain at the garage a corps of commercial engineers. It will be the duty of these engineers to call upon business men at their request and give definite information as to comparative cost of horse drawing and electric trucking as applied to any kind of business. This investigation and report on cost of electric trucking in connection with any business house will be given without charge.

A policy which has been pursued with the pleasure electric garage to the great satisfaction of patrons will apply in the management of the electric-truck garage. That is a system of record keeping and inspection, which has worked so well there that it has been copied throughout the United States. The owner of a single truck is assured by the garage the same high degree of efficiency that is obtained by the owner of a larger installation who can afford to hire his own experts. The owner of an electric truck can now know in advance exactly what it is going to cost to operate his truck.

While the Union Electric will sell electric trucks of well known makes, the truck garage will be conducted in such an impartial manner as to give equally efficient service to all electric trucks, whether sold by the Company or bought from representatives of other manufacturers. This was one of the policies observed strictly in the conduct of the garage for pleasure electrics where cars were cared for with the same thoroughness and attention to detail, whether purchased through the Company or through other agents.

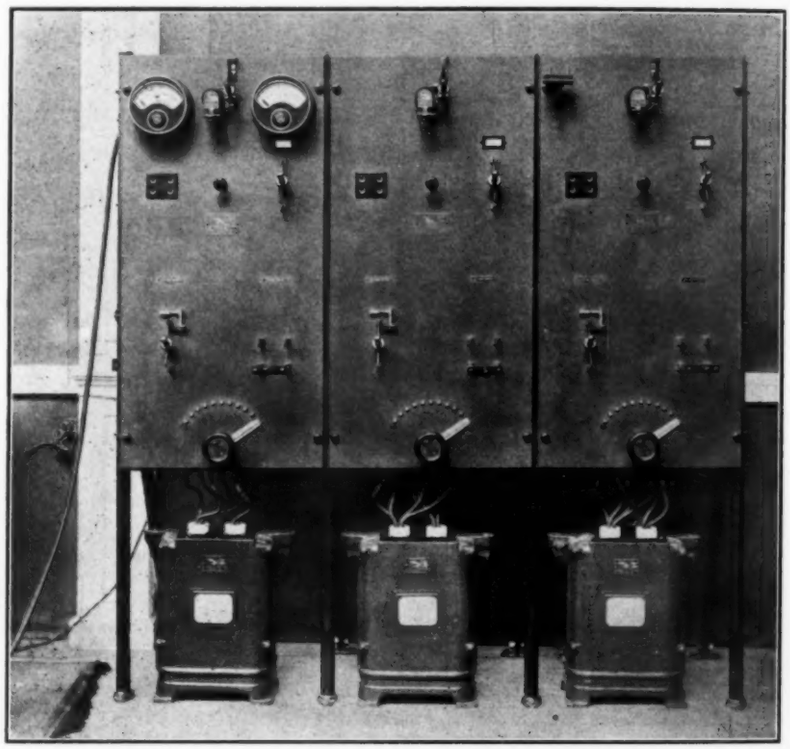
Electric trucking in St. Louis, even without the advantage of the central garage, has proven its economy to the satisfaction of a number of business houses. The commercial engineers who have followed the problem to its solution believe they can demonstrate the saving of many thousands of dollars by the substitution of electric for horse power in the wholesale and retail districts, not to mention the economy in street wear and the advantage of cleanliness.

New Form of Mercury Rectifier.

An improved type of mercury-arc rectifier for commercial vehicle service has recently been put upon the market. This rectifier is of the ordinary type except that many of the parts necessay for use with pleasure vehicles are now eliminated on account of the standard voltage requirements of commercial vehicles, where forty-four cells are used almost exclusively.

The charging board, shown in the illustration, is decidedly substantial in character, the wiring simple and ample in carrying capacity. A most efficient board is produced at the lowest price by a plug system enabling one set of meters to be used for every three panels, each of which can be equipped with any of the standard tubes ranging from 30 to 50 amperes each. Where necessary this rectifier is supplied with a special switch on each panel, enabling two or more panels to be run in multiple so as to accommodate charging of batteries at high amperage.

The meters supplied are of the large type easily read by the operator, and the whole arrangement has met with



CHARGING PANELS FOR USE WITH NEW MERCURY RECTIFIER.

the most cordial approval of the central-station people who have closely examined the equipment.

This equipment is made by the General Electric Company and was shown for the first time at the New York Electrical Show by the General Vehicle Company. A practical demonstration was given by operating the 3.5-ton chassis direct from the board without battery, forming one of the most popular exhibits.

High-Voltage Air-Break Switches.

When designing a high-tension transmission line considerable study is given to the selection of the proper type of apparatus for controlling and protecting the high-voltage transmission circuits. Owing to the rapid development and efficient design of the present day transformer, high-tension transmission lines are quite common in this country. It is safe to state that there would not have been such marked progress if it were not for the ability of the manufacturers to design and produce an effective means for controlling these high voltages. This has been successfully provided in the present day oil-switches and circuit-breakers. In the course of this development the oil-switch has passed through many changes, and, even at this date, there are conditions

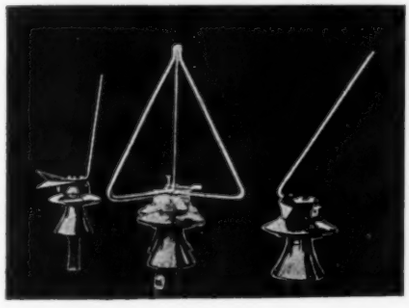


FIG. 2.

to which the oil-switch is not adaptable, the chief one being out-door mounting.

In this connection attention is called to the line of Burke high-voltage air-break switches being placed on the market by the Railway & Industrial Engineering Company, Pittsburg, Pa. These switches operate on the well-known fact that an arc can be extinguished on a pair of diverting horns, which principle is used successfully on the electrolytic or aluminum-cell type lightning arrester.

Referring to Fig. 1, which illustrates a single-pole double-throw 25,000-volt 200-ampere Burke air-break switch in the closed position, it should be noted that the circuit entering the middle of the switch is carried jointly by means of a heavy switch blade, and the diverting horns, to the switch jaws, and thus to the outgoing line. These shunted horns are so arranged that when the switch is closed there is considerable torsion in the center horns. Thus when the switch is opened the switch blade

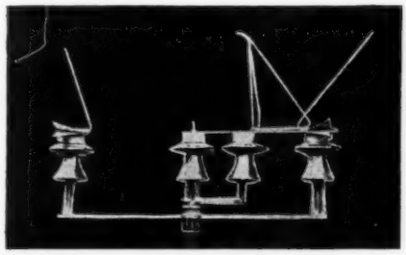


FIG. 1.

leaves the switch jaws while the horns are in contact. This is clearly shown in Fig. 2.

When the switch is further opened, the arc starts and extinguishes itself, due to the widening of the gap, brought about by the joint action of the arc rising on the diverting horns and the switch opening. It is said to be impossible to burn the switch blade, the switch jaws, or in any way damage the switch when opening a loaded circuit.

The switches are manufactured in single-pole units, each unit consisting of a stationary and a movable casting, as shown in illustration Fig. 1. In the stationary casting is provided a brass bearing. The movable casting has an extended stem, part of which is accurately machined to fit this bearing, the remainder being squared off to receive a bell crank or sheave wheel. A curved brass washer is placed between these two castings to prevent water entering the bearing. On the extended arms of each of these castings is cemented a high-voltage porcelain insulator. A sherardized iron cap of special design is placed on the top of these insulators. This cap is not cemented, but attached by special means, enabling it to be readily removed if necessary. The switch blades, horns, jaws, etc., are bolted to these caps. All the screws and bolts entering into the construction are sherardized to prevent corrosion. By means of bell cranks any number of these units can be connected together.

Guayule Rubber Industry in Texas.

Gathering the guayule shrub to supply the large rubber factory at Marathon is an important industry in Texas. The territory where this valuable shrub grows wild extends for a radius of 50 to 200 miles around Marathon. It is cut upon the ranches, baled and hauled in wagons to the factory. The market price of the shrub was recently as high as $150 per ton but it now sells for something less than that, the reduction being due to the fall in the price of crude rubber.

The great demand for this desert shrub which was considered worthless until a few years ago is causing the lands to be ruthlessly depleted of the product. Upon a few of the ranches of this section steps have been taken for the further propagation of the shrub but in most instances it is being pulled up root and branch, leaving nothing behind for starting a new growth. When the fact is considered that with proper attention an average of two tons of the shrub can be grown upon land that is unfit for almost any other purpose, and that this yield can be obtained every two or three years, it is remarkable that so little attention is given to making it a permanent future source of revenue. Two years ago the state of Texas sold all the guayule shrub growing upon

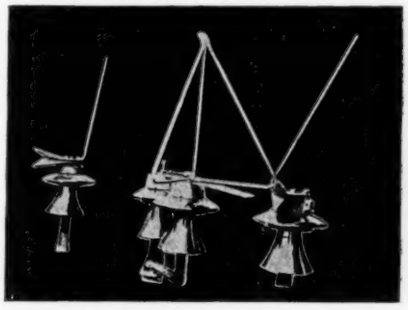


FIG. 3.

several million acres of public domain in this region for $60,000. The purchaser has already realized a profit of several hundred thousand dollars upon his investment. It is these state lands, chiefly, that are being entirely depleted of the shrub.

In the upper Rio Grande border region of Northern Mexico where the guayule rubber industry has made such wonderful strides during the last few years much attention is being given to insuring a permanent supply of the raw product.

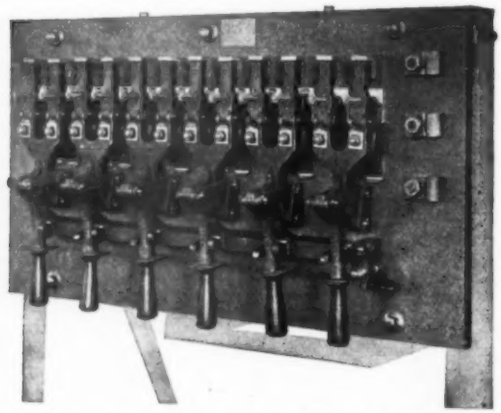
Alternating-Current Motor Starter.

In starting large motors and those operating under heavy starting conditions the heavy currents resulting cannot be handled in the best manner by apparatus having sliding contacts. The arcing and wearing of the contacts is excessive. For such use a device is necessary which will stand the severe service with minimum chance of wear. A multiple switch starter recently put on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, has the qualities of design and construction which make it especially adapted for starting of large or heavily loaded two or three-phase, slip-ring motors. The standard sizes made range from 60 to 600 horsepower.

Many features of the Cutler-Hammer direct-current, multiple-switch starter have been embodied in this alternating-current device. No sparking at the switch can occur in starting whether loaded or not. The switches are not like ordinary knife switches, but are of circuit-breaker construction, making full contact instantly. Besides doing away with sliding contacts the multiple switch starter prevents the hasty cutting out of resistance, as each switch must be closed separately, beginning at the left. The time taken insures a smooth acceleration to the motor and prevents injury due to large current inrush.

The contacts of the switches are so connected that the resistance is cut out of the phases of the secondary at the same time. The currents in the legs are therefore approximately equal and an electrical balance is maintained. The motor is started under the best conditions, each phase producing its share of the total torque. This type of starter is claimed to be the most serviceable for use with large motors.

Automatic no-voltage and overload release can be provided for opening the primary circuit and re-inserting the secondary resistance in case of failure of current or overloading of motor.



ALTERNATING-CURRENT MOTOR STARTER.

Interior Telephone System in a Residence.

Many people have come to consider an interior telephone system an indispensable auxiliary in a home. Its convenience and inexpensiveness make it a standard feature of house equipment. The old, unsanitary method of intercommunication by means of speaking tubes has been relegated to the past. The up-to-date residence is modeled closely after a business establishment. The telephone performs the services that formerly called for many trips up and down stairs and other awkward methods with their attendant confusion and noise.

Illustrating the inter-phone method of solving the problem of interior connections, the accompanying cut is from a photograph secured in a handsome new house in Pittsburg. The residence is that of J. W. Marsh, president of the Standard Underground Cable Company. Thirteen instruments have been installed, interconnected in such a manner that each inter-phone may be considered the center of the system.

The instruments selected for this installation are of two types, wall sets with telephones and connecting keys in one case and hand telephone sets used in conjunction with connecting keys in separate boxes. It is through the medium of these keys that automatic connection is secured.

No switchboard or operator is required with this system. With each inter-phone are provided rows of keys resembling small black buttons, each with its label bearing the name of one of the inter-phone stations. The gentleman in his library can press the button labeled "garage," lift his receiver or hand set to his ear and obtain instant connection with his chauffeur without the intervention of any third party.

In the accompanying illustration is shown the installation of the library inter-phone in the Marsh residence. Here the key-box is contained within a pigeon-hole of the desk in a manner inconspicuous yet convenient. Other sets have been installed in the living room, dining room, kitchen, laundry, garage, bedrooms and nursery. Each of these household departments is at all times within instant reach of all the rest of the house.

INTER-PHONE IN LIBRARY.

Homes which are equipped with inter-phones transact their affairs of routine and their everyday household matters in a businesslike way, yet with very little extra expense. The cost of keeping up an inter-phone system is not greater than maintaining an electric door bell. The renewal of the two or three dry batteries constitutes the only expense that may be classed as maintenance cost. The system in Mr. Marsh's residence has been arranged so that as many as seven or eight additional instruments may be added. The inter-phones were made and installed by the Western Electric Company.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, DECEMBER 10.—A change is coming over the scene as regards municipalities being granted powers to wire premises for electric light and to hire out electrical apparatus. The conference between the municipalities and electrical contractors appears to be fostering such a spirit of reasonableness that there is every probability of an amicable settlement It may not unfairly be said that the increasing strength of the Contractors' Association has played its part in bringing about the conference, for there cannot be any doubt that they would have successfully prevented a bill on the lines originally laid down, passing through Parliament. The matter is of considerable importance to the industry as a whole, for the constant bickerings between municipal electricity departments and the contractors have undoubtedly retarded the progress of electricity supply.

Arrangements are being pushed forward for linking up the numerous public electricity supply works in London. As the result of the various attempts in Parliament to promote new companies the existing authorities were forced to take common action to protect their own interests. Their last effort at opposition a few years ago proved successful, for it was accompanied by a scheme for joining up with trunk mains all the existing works and thus putting to much more profitable use the large amount of capital expended. Parliament took the view that this was the more economical way and sanctioned the proposal. Owing to the large number of systems of generation at various voltages, a standard unit of transformation is being agreed upon in conjunction with a ring main system. Already several authorities generating near to one another have made their arrangements for bulk supply in case of emergency, but the larger scheme will permit of closing down some of the smaller and less economical stations.

The Bournemouth Corporation has definitely abandoned the conduit system of electric traction in its streets and is advertising for tenders to convert the lines to the trolley system, thus having the latter throughout the whole of the borough.

Considerable progress is being made in the application of Diesel oil engines to small electricity works. Last week a small Diesel engine-driven set was put into operation at Felixstowe, a small town on the east coast, and the fuel costs only amount to .36 cent per kilowatt-hour at full load and .44 cent at third load. It is also interesting to note that but for the adoption of the Diesel engine the works would have had to be moved, owing to complaints from residents in neighboring houses of smell and noise from a producer gas plant. The capacity of the set is 150 kilowatts. Similar low fuel costs are being obtained with Diesel engines at Maidenhead, Leatherhead and Letchworth. G.

CANADA.

(Special Correspondence.)

OTTAWA, ONT., DECEMBER 17.—Application has been made to Dominion Parliament for an act to incorporate the Imperial Traction Company, with power to construct and operate railway, telegraph and telephone lines in Ontario.

A bill has been introduced in the Canadian Parliament, by a private member, proposing to have wireless telegraphic apparatus established on all vessels, over a certain tonnage, on the Great Lakes.

The Hydro-Electric Commission of Ontario has made arrangements to furnish 1,500 horsepower to the towns of Midland and Penetanguishene, Ont., through the Simcoe Power Company's plant located at Big Chute.

Information from an authoritative source is to the effect that the London (Ont.) Street Railway, the London Electric Company and the London & Lake Erie Traction Line to Port Stanley, all in the province of Ontario, are to be merged shortly.

A cable from London, Eng., announces the formation there of the Montreal Tramways & Power Company, with a capital stock equivalent to $20,000,000 of Canadian money, for the purpose of acquiring electric street railways and power-supply concerns in Canada. Montreal electric interests disclaim any connection with it.

Wireless communication, between the Magdalen Islands, in the Gulf of St. Lawrence, and the mainland of Nova Scotia, has been established and is now in operation. The wireless station has been erected by the Dominion Government. Last year for several months the cable was down and the islands shut out from communication with the outside world.

During the past season there have been many large shipments of Canadian mica to Great Britain. The trade in this mineral is on the increase between the two countries, despite the fact that Indian mica can be marketed much cheaper. The amber mica, as the Canadian product is called, is of a softer variety and more used in electrical work. A few years ago there was no sale at all of Canadian mica in the old country.

The announcement recently of the formation of a $10,000,000 company, with head offices in Toronto, caused considerable speculation in Ontario financial circles. The new concern is styled the Central Canada Power Company, Limited, and under its charter it may carry on a general hydraulic and electric business all over the Dominion. The incorporators are only nominal, being members of a Toronto legal office. Among those who follow industrial electric affairs, it is said that the new company is practically a merger of all the lines in the West, and that it will not operate in Ontario where the Hydro-Electric Commission has captured the field. W.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

PROPOSED DEVELOPMENT IN NEW MEXICO.—Definite steps have been taken looking to the installation of a large hydroelectric plant to be operated in connection with the Elephant Butte dam and land reclamation project that is now being constructed by the Government. The Water Users' Association, which is composed of the land owners of the Rio Grande valley who will irrigate from the big water storage and canal system which the Government is putting in, has had an investigation made of the proposed hydroelectric project by competent engineers. One of the engineers in a recent report said that the cost of installing the hydroelectric plant and constructing electric transmission lines down the valley on both sides of the river would be approximately $326,000, or an average of $27 per acre for the land that is to be irrigated. The prime object of the hydroelectric enterprise is to provide power for operating irrigating pumping plants where the water cannot be placed upon the land by means of gravity. In addition to providing power for operating the pumping plants there will be a large surplus of electrical energy available for the use of private industries and municipal service covering a big scope of territory on both the American and Mexican sides of the Rio Grande, it is stated. D.

COMMISSION NEWS FROM MASSACHUSETTS.

(Special Correspondence.)

A recent decision of the Massachusetts Gas & Electric Light Commission involving both street-lighting rates and the maximum net price for electricity sold to commercial customers in the city of Newburyport is significant of the attitude of the Board on the question of discounts. The Newburyport Gas & Electric Company recently entered into negotiations with the municipal authorities for the renewal of the street-lighting contract, and offered the City a price of $95 per arc lamp per year on all-night and every-night service for a one-year agreement. The Company informed the City that if it would sign a five-year contract, the price per arc lamp would be $90. The Commission ordered the Company to put the lower price into effect on a one-year basis, in case the City desires to make a contract lasting only twelve months. The Board feels that street lighting involves comparatively little risk under the Massachusetts laws, judging from this decision. The Commission emphasizes the fact that no changes in the street lighting equipment are required, so that little if any additional investment must be made by the Company in meeting the needs of the next period of street illumination.

The Board also required the Company to reduce its maximum net price from sixteen to fourteen cents per kilowatt-hour. The former maximum gross price was in the neighborhood of twenty cents per unit, with a reduction to sixteen cents for prompt payment. The Commission recognized the justice of a reduction for punctuality in meeting the bills, but stated that the function of the discount would be attained if the discount or margin between gross and net corresponded more nearly in proportion to that in force with the gas charges of the Company.

COMMISSION NEWS FROM INDIANA.

(Special Correspondence.)

The recent conference of interurban men with the Governor and the Railroad Commission was well attended and the inquiries made by the Governor were thoroughly discussed.

The principal requirements insisted upon by the Governor and the Commission were that interurban managers in order to procure move efficient motormen be not allowed to hire or put in charge of a car motormen unless they had at least one year's experience as a railroad man; that motormen be prohibited from handling baggage and that all roads operating more than forty trains a day be required to install some system of block signaling on their lines.

The Governor stated that the main purpose is to make the service safer and make the people believe that interurban transportation is safe. He said unless the traction lines were willing to follow out the recommendations of the Commission the Legislature would be inclined to enact some drastic legislation. This he hoped to forestall and thought he would be able to do so since the traction men seem willing to carry out the recommendation of the Commission as shown in the following abstracts from its report:

The Railroad Commission of Indiana in its report to the Governor respecting interurban wrecks said that conclusions as to the cause of the disastrous wrecks were reached without much difficulty, but the recommendation of a practical and efficient remedy for such accidents under subsisting conditions of interurban organization, operation and revenues is far more difficult.

"It is clear to us that these operating conditions are incompatible with safety, and that fatal accidents must continue to occur unless there are radical changes and betterments; that on the one hand, the public demands, and has the right to demand, a much higher degree of safety than these lines now afford, and this proper factor of safety can be secured only by the expenditure of larger amounts of money than is now used, in the employment of competent, trained, experienced men, and the installation of adequate safety devices, and by holding to criminal responsibility whoever by flagrant neglect causes these fatalities. On the other hand, it is equally clear that if this is done, as it ought to be, that there will be little or nothing left, passing all questions of dividends on stock, to pay interest on the bonds of some of these interurban companies."

After reviewing the causes and consequences of the recent fatal interurban wrecks, the Commission makes among others the following recommendations: (1) That block systems may be applied to and used on interurban railroads, which, according to experts is entirely feasible; (2) to secure better railroad men of longer experience in the service.

In addition to the above the Commission recommends additional legislation empowering railroad companies to condemn and remove obstructions located on land adjacent to the right of way where the same interferes with safe operation.

The Commission also recommends criminal prosecution where the officers or men of interurban companies, including their directors, carelessly and negligently do or omit to do an act, from which the death of passenger or employe results. S.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

At a hearing of the New York Public Service Commission, First District, regarding subway congestion, E. J. Connette stated that with the use of the new electropneumatic braking device the headway of express trains could be cut down from the present value of one minute and forty-eight seconds to one minute and thirty seconds. Frank Hedley, general manager of the Interborough Rapid Transit Company, took the view that the congestion of traffic and overcrowding of the cars laid rather with the public than with the Company.

After a hearing held recently the Commission granted the application of the North Shore Electric Light & Power Company for a rehearing on its application for permission to construct a transmission line in the towns of Brookhaven and Smithtown, Suffolk County. This application was denied by the Commission on June 1, 1910, because the territorial area sought to be served was being lighted by the Port Jefferson Electric Light Company, and the Commission held that the communities in question were not large enough to afford sufficient demand for two electric light companies. The date for rehearing will be scheduled for some time in January.

The Commission has taken evidence on the application of the Port Jefferson Electric Light Company for permission to issue $30,000 in mortgage bonds and for authority to execute a mortgage. The proposed bonds are to be of the denomination of $500 each and are to pay existing debts of the Company, covering cost of installation of proposed new apparatus to the Company's plant. The Commission reserved decision.

Members of the Village Board of South Glens Falls recently testified on the application of the receivers of the Hudson River Electric Company, asking the Commission's approval for the execution of a contract for public lighting with that village. They all testified that the present service by the Glens Falls Gas & Electric Company and the United Gas, Electric Light & Power Company is not adequate. These existing companies vigorously contest the entrance of a competitor into South Glens Falls. Decision was reserved by the Commission.

The Commission has received a petition from the Bolton Light & Power Company, of Bolton, Warren County, asking for its approval of the issuance of $12,500 common capital stock and ten-year six-per cent mortgage bonds to the amount of $10,000 secured by a mortgage upon all of its property in the village of Bolton Landing, Warren County. The Company has received the franchise for the lighting of streets in that village and asks the Commission's consent to exercise that franchise. It intends to furnish electricity for commercial purposes to manufactories in Caldwell and in the adjacent village of Hill View. It will also furnish energy to residents of this locality. The territory in question is not at present supplied with gas or electric light.

The Commission has also received the petition of the Owego Light & Power Company of Owego, Tioga County, N. Y., requesting permission to issue its bonds secured by a mortgage on its property to the amount of $40,000. The proceeds of the bonds are to be used to retire existing bonded indebtedness of the Company which has been incurred in the extension of its plant and distributing system and to cover cost of future improvements. The Company asks for a present authorization of $32,000 and the remaining issue of $8,000 is to be held in the treasury subject to the further order of the Commission.

The Commission has granted permission to the Dunkirk Power & Heating Company and the Dunkirk Distribution Company to consolidate into one corporation to be known under the name of the Dunkirk Power & Heating Company. The outstanding stock of the Dunkirk Distribution Company is to be convertible into the capital stock of the new corporation share for share, and the existing capital stock of the Dunkirk Power & Heating Company is to be exchanged at the rate of one share of the new corporation for five and three-fourths shares of the Dunkirk Power & Heating Company. The new corporation is authorized to issue capital stock to the amount of $3,000 to pay for actual improvements and extensions of its distributing system.

The Commission has dismissed the complaint of the Islip Electric Light Company as to alleged unlawful stringing of wires of the Sayville Electric Company in East Islip, Suffolk County, it appearing that the Sayville Company is entirely within its legal rights in supplying electricity to any part of that town under the terms of franchise which it has received.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The Lancaster Electric Light Company petitioned the Commission to be allowed to put into effect a minimum monthly bill of $1.00 per consumer. The Company has in effect a meter rate of 12.5 cents per kilowatt-hour and states that many of its consumers use only from one-half to three kilowatt-hours per month and that the revenue from these consumers did not reimburse the Company for its expenses incurred in serving such customers. It appeared that the Company owned some of the meters and that the consumers owned meters also. The Company charged a meter rent of 25 cents per month to those consumers using meters owned by it. The Commission, after careful analysis of the operating expenses of the plant and paying particular attention to those expenses known as "consumer" expenses, granted the Company a minimum charge of seventy-five cents per month per consumer. The Commission pointed out that the minimum charge guaranteed those expenses which were covered by the meter rental provision, and that the meter rent provision now in force should be abolished.

The Mt. Horeb Electric Light Company requested authority to increase its rates for thirty-two-candlepower incandescent lamps for street lighting from $1.00 to $2.00 per month. The Commission found that no attempt had been made by the Company to keep its books in compliance with the uniform classification of accounts as prescribed by the Commission and that it was necessary to resort to estimates in finding the expenses of the plant. It was also necessary to estimate the output.

The Commission on its own motion investigated the reasonableness of the rates, rules and regulations of the LaCrosse and Onalaska Street Railway Company. It appeared that the Company operated a line about two miles long between La Crosse and Onalaska. One car is operated on this line on a thirty-minute headway. The testimony and the investigation of the Commission showed that the service rendered was unreasonably inadequate and the Commission ordered the Company to cease operating the car now in use and to substitute a car of sufficient carrying capacity and provided with such appliances as will render the same comfortable to passengers traveling thereon in inclement weather. The matter of rates was held in abeyance pending the decision in the matter involving the entire question of rates of the LaCrosse & Onalaska Street Railway Company.

LIGHTING AND POWER.

(Special Correspondence.)

KIOWA, KANS.—This city is about to enlarge its electric light plant. P.

STILWELL, OKLA.—This city has voted $5,000 in bonds for an electric light plant. P.

LOVELL, WYO.—This city has voted $7,000 for the installation of an electric light system. P.

MARION, ALA.—The Marion Electric Company has been incorporated with capital of $10,000.

BERTHOLD, N. D.—John K. Moore, of Minot, N. D., has been granted an electric light franchise. P.

ANSLEY, NEB.—This city has voted bonds for $5,000 for the installation of an electric light plant. P.

BONAPARTE, IOWA.—S. E. Irish is organizing a company to establish an electric power plant here. P.

SEATTLE, WASH.—The Bellevue Electric Company has been incorporated with a capital of $500,000. P.

YORKTOWN, IND.—The town board is preparing to install an electric lighting system. S.

MUSSELSHELL, MONT.—Handel Brothers are promoting the installation of an electric light plant here. P.

LAMPASAS, TEX.—The Lampasas Light & Power Company has purchased the electric plant of Frank Beauman. P.

NASHVILLE, ARK.—An electric light franchise has been granted to the Nashville Ice, Coal & Light Company. P.

JACKSON, CAL.—John L. Henry has applied for a franchise to erect electric lines for all purposes in Amador County. A.

CLARKSVILLE, TEX.—The Clarksville Light Company is preparing to rebuild its plant which was recently burned. P.

WAUSAU, WIS.—The Board of Public Works has been authorized to secure estimates and plans for a municipal lighting plant.

GREENVILLE, CAL.—The Indian Valley Light & Power Company will extend its lines next year to Taylorsville, Crescent and Seneca.

CARROLL, IOWA.—Ornamental lamp standards will be installed by business men of the city, the municipality supplying current. Z.

LAS CRUCES, N. M.—The Las Cruces Electric Light and Ice Company has extended its electric lighting system to the town of Mesilla Park. D.

MONTEREY, CAL.—The Pacific Gas & Electric Company has completed the absorption of the Monterey Gas & Electric Company of this place.

PECATONICA, ILL.—The Village Board has granted a fifteen-year franchise to Arthur Waterstreet to operate an electric-lighting plant in the village. Z.

OPELIKA, ALA.—The city has leased the plant of the Opelika Electric Light Company for a period of four months. The lease went into effect on December 1.

FLANAGAN, ILL.—A power plant to supply electricity for lighting purposes and operating machinery is being installed at the Amish orphanage near this place. Z.

BROOKVILLE, IND.—The Commissioners of Franklin County are advertising for bids for the installation of electric apparatus and fixtures in the new County Court House. S.

WELLSVILLE, MO.—The Wellsville Light, Power & Water Company has been incorporated with a capital stock of $15,000. The incorporators are C. H. Early, J. T. Mitchell and E. R. Barrett. Z.

MOORESVILLE, IND.—The Mooresville Water, Light, Heat & Power Company has been incorporated with a capital of $100,000. The incorporators are E. L. Deupree, Clarence Deupree and E. H. Emrick.

MORRIS, ILL.—The machinery for the Illinois Valley Gas & Electric Company at the pumping station will probably be installed and in operation by January 1, when the city water will be pumped by electricity. Z.

VICTORIA, B. C.—An election will soon be held here to authorize the raising of $25,000 for the purchase of electrical equipment for the extension and improvement of the street-lighting system of this city. A.

HERMISTON, ORE.—A franchise has been granted to B. A. Chisholm and G. A. Chisholm for constructing and maintaining an electric lighting plant in this city. Construction work is to commence next year. A.

LA SALLE, ILL.—Mayor Thomas F. Doyle, in a special message to the City Council, declares the present lighting system is inadequate and urges that steps be taken to devise a more extensive and more modern plan. Z.

MURRAY, IDAHO.—It is reported that the Thompson Falls Water Power Company is surveying a right of way from Thompson, Idaho, to Burke and this city and will soon stretch wires to furnish power to the Idaho mines. A.

TOLEDO, WASH.—E. P. and A. R. Badger of this place have secured a franchise for the erection and maintenance of an electric lighting plant here. They have also been awarded a ten-year street lighting contract by the City.

OROVILLE, CAL.—Manager R. L. Van der Naillen, of the Oro Water, Light & Power Company of this place, announces that during the coming year his company will spend $70,000 on improvements to its distributing system here. A.

STOUGHTON, WIS.—The town of Stoughton has decided to purchase from the Stoughton Mill Company its power dam across the Yahara River here for $18,700. Power for lighting and pumping purposes will be obtained from the dam. M.

OAKLAND CITY, IND.—The Oakland City Light, Fuel & Power Company has sold its property to a company from Lawrenceville, Ill. The plant is to be remodeled and new equipment installed. The sale includes the franchise and some oil lands. S.

MONTGOMERY, ALA.—The Citizens Light, Heat & Power Company, which is owned principally by Richard Tillis, will increase the capacity of its plant to about 10,000 horsepower. Steam turbines and auxiliary equipment are to be installed.

LEESBURG, IND.—The Leesburg Light & Water Company will have its new electric plant in operation by February 1, according to present plans. The town has been almost in total darkness the past few months, owing to the poor condition of the old gasoline lights.

VALLEJO, CAL.—E. D. Crowley, of San Francisco, will early in January start construction on a new central power station for the Navy Department at the United States Navy Yard at Mare Island near this city. Work is to be completed before the end of spring. A.

FLORHAM PARK, N. J.—After having been before the Council for about a year, the ordinance providing for street lighting has been passed. The main thoroughfares will be lighted at first and the remaining streets as soon as the borough can reasonably bear the expense of taxes.

WICHITA, KANS.—The new power house of the Kansas Gas & Electric Company was recently put in partial operation. It will be some time before the turbines are ready for use in the new power house, but while they are being placed smaller machines will furnish current.

PAYETTE, IDAHO.—The Salem Falls Light & Power Company has been incorporated here by Mr. Wright and associates with a capital stock of $100,000. Mr. Wright announces that his company has secured water rights and a site on which from 2,500 to 3,000 horsepower can be developed. A.

PEKIN, ILL.—The Pekin Light, Heat & Power Company, it is said, contemplates installing a new dynamo and engine capable of developing 750 horsepower at the local plant. Tentative plans include supplying power for the city lines of the proposed Pekin & Petersburg Interurban Railway. Z.

AMERICAN FALLS, IDAHO.—Governor Brady, who controls all the stock of the Idaho Consolidated Power Company, announces that 30,000 additional horsepower will be developed here during the coming year by his company. The company plans to have this new plant the main one of its system. A.

STAYTON, ORE.—A. L. Shreve, proprietor of the Stayton Electric Light Plant, states that he has just purchased a power site three miles up the Stayton River from here. The site, upon which modern power houses will be built in the coming year, is capable of generating 5,000 horsepower. A.

LONG BEACH, CAL.—The Edison Electric Company, which is building a large power plant here, has let a contract for the construction of a reinforced-concrete, brick, stone and steel structure to the F. O. Engstrom Company of Los Angeles for $134,550. The building is to be completed by February 1. A.

SANDUSKY, O.—Mayor George T. Lehrer has vetoed an ordinance recently passed by Council giving the Sandusky Gas & Electric Company the right to charge two prices, five and eight cents, for electricity, for the reason that the ordinance as drawn does not suitably provide for the double rate. H.

LANGFORD, S. D.—The residents of Langford have inaugurated a movement to have the town provided with an electric lighting system. The City Council may be asked to call a special election to vote bonds for the purpose, or local capitalists may organize a stock company and establish and operate a plant.

CARLINVILLE, ILL.—The Macoupin County Board of Supervisors has given the Board of Management of the county farm authority to install a lighting plant at that institution and investigation is to be made of the possibilities in this line. Use of power from the line of the Illinois Traction System has been suggested for this purpose. Z.

NEW RICHMOND, WIS.—Another electric power transmission project on the Kinnickinnic below River Falls is under way. Flowage rights have been secured from a number of farmers. A dam and power plant will be erected during the coming winter and the power will be transmitted to Prescott, Wis., and Hastings, Minn.

HELENA, ARK.—It is stated that the Helena Gas & Electric Light Company of this place will shortly be sold to the Scofield Engineering Company, of Philadelphia, which concern has an option on the property of the Helena Company. The local plant is owned by Helena capitalists, and the property is valued at $135,000. I.

PALISADE, COLO.—The town board has agreed to grant an electric light franchise to the Mutual Light, Power and Telephone Company, provided the promoters will put up a cash bond of $5,000 to carry out the provisions of the proposed franchise. Hendrie & Bolthoff of Denver took over the old plant and have recently been operating it.

BELVIDERE, ILL.—Petitions are being circulated to have a proposition that the City build and maintain a municipal lighting plant placed upon the ballot at the next city election. The contract of the Municipality with the Public Service Operating Company expires in January and proposals have been made for a new ten-year contract. Z.

MOLINE, ILL.—Illumination to allow harvesting of ice by night as well as day will be furnished to the ice fields of the Union Ice & Fuel Company of Moline and Rock Island by electric lights

fed from independent dynamos in the two plants. The Company expects to harvest 50,000 tons and all available time must be utilized while the ice is in shape. Z.

ST. LOUIS, MO.—Electrical apparatus which will supersede the negro roustabouts in loading lumber on barges on the Lower Mississippi River will be used by the Mississippi Valley Transportation Company, according to Secretary John L. Mathews of the Company. Negotiations are now in progress for outfits to be installed upon four docks of the Company. Z.

SPRINGFIELD, ILL.—Property owners on South Grand Avenue have made an offer to the City Council to install boulevard lights if the municipality will supply the current. Council committees have favored the project, as the cost would be less than the maintenance of the present arc lights. The city officials have been instructed to get prices on an additional dynamo. Z.

GRAND FALLS, N. B.—The Grand Falls Company, Ltd., with a capital stock of $1,200,000, has been incorporated for the purpose of developing the water power here. The incorporators include Sir William Van Horne, H. S. Holt, president of the Royal Bank of Canada; George F. Underwood, vice-president of the International Paper Company of New York, and other capitalists.

WINNEMUCCA, NEV.—Geo. Wingfield has purchased three ranches on the Humboldt River on which he will build a power plant next year for the operation of a reduction plant for the Buckhorn mines. He will first build a dam 100 feet high, which will cost $150,000 and will back the water up into a reservoir. This will provide all the water necessary for generating electric power. A.

PAYETTE, IDAHO.—The Telluride Association states that within two months it will construct a power plant near the confluence of the Malas and Snake Rivers. The plant is to cost $2,000,000 and will generate 10,000 horsepower. J. J. Nunn, manager of the Gale light plant in La Grande, Ore., has been awarded the contract for constructing the plant, which is to be completed by March 1, 1911. A.

ROCK HILL, S. C.—Taking the first definite step towards municipal ownership, this town has awarded the contracts for electrical equipment for the proposed new plant. The bids for the power house and engine were not included, as not sufficient copies of specifications, etc., had been made to supply the demand. Dr. J. B. Johnson, Rock Hill, is chairman of the Board of Commissioners. L.

RALEIGH, N. C.—In a report just issued by the state covering a total of 655 factories of various kinds, it is shown that with an aggregate capital of over $50,000,000, 110 factories use electric power including the electric drive, popular in cotton mills, while 419 report steam power and twenty-seven report both steam and electric power, and about six report various combinations, including electricity in each case. L.

MADISON, WIS.—A preliminary assessed valuation of $42,788,000 has been placed on the street railway, light, heat and power utility companies of Wisconsin by the State Tax Commission. This is an increase of $2,318,000 over the preliminary valuations of last year. The largest increase was made of the Milwaukee Electric Railway & Light Company, from $23,500,000 in 1910 to $24,400,000, an increase of $900,000. M.

TREMONT, ILL.—The Morton Light, Heat & Power Company has closed a contract to light the streets of this village and also will sell current to business houses and residences. Until June 1, 1911, the Morton Company will operate the local plant and after that time a line will be run from Morton, making the plant here a sub-station. In addition the outside equipment has been sold to the new service concern. Z.

KNIGHTSTOWN, IND.—The State Board of Accounts condemn the present plan of operating the Knightstown municipal lighting plant. It was found that many persons were getting light free of charge; that others were getting service below the established rate and that little effort was being made to collect amounts due from customers. The plant is about worn out and there is no money for repairs which are now necessary. S.

HATFIELD, WIS.—The report that the La Crosse Water Power Company is to sell its power plant here to the Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Company has been denied by the officials of both companies. No negotiations are being carried on between the companies for the purpose of the plant here. It is stated by M. W. Savage, president of the Traction Company, that the Company is to erect and operate its own powerhouse. M.

PRAIRIE DU SAC, WIS.—The Wisconsin River Power Company has started survey work for its dam across the Wisconsin River near Prairie du Sac and has sent its engineer, R. G. Walter, to superintend the preliminary construction work. According to the plans of the Power Company the dam will be 1,500 feet long, with 1,000 feet of spillway, the balance to be used for locks, and will have a head of twenty-five feet, generating 26,000 horsepower. Power will be transmitted to Milwaukee, Madison and to the mines at North Freedom. A small part of the power will be used by local industries. M.

CARTHAGE, N. M.—Stackhouse & Brown of Carthage have made a proposition to the Federal Government to extend an electric transmission line from their power plant at Carthage to the site of the proposed Elephant Butte dam and to furnish power that may be necessary for carrying on the construction work there, as well as to provide lights for the construction camp. If the proposition is accepted the line will be constructed at once. It will be about seventy-five miles long. Stackhouse & Brown will erect a power plant for this special purpose and to provide power for the Kelly and Mogollon mining districts. D.

PHILADELPHIA, PA.—The Philadelphia Electric Company was the only bidder for the electric lighting of the city during the next year. As compared with the prices paid this year the Electric Company asks a fraction below one and one-half cents per light per night less for 1911, which, on the basis of the present number of lights, represents a total reduction of $75,000. Altogether, the Company will receive for its street lighting service this year $1,213,316. For each of the new ornamental lamps in 1911 the Electric Company asks twenty-seven cents per night and for arc pole lights twenty-five and one-half cents per light.

BIRMINGHAM, ALA.—The City Council of Birmingham has granted a franchise for thirty years to the Coosa River Development Company to furnish lights to the City, the terms of the franchise being that the Company must furnish the City lights within the next three and a half years. The franchise specifies that the Company shall furnish the City lights at the rate of eight cents per kilowatt hour, with a discount of 12.5 per cent for prompt payment. The charge per hour for private arc lights for a 425 watt-lamp all night shall be thirty cents. The charge for a private 1,200-candle-power lamp to 12 o'clock shall be twenty cents, with a ten-per cent discount. I.

ROCKINGHAM, N. C.—W. A. Leland, resident engineer of the Blewitt Falls hydroelectric plant on the Pee Dee River, has taken the initial legal steps for the deeding of the entire plant to Edward Clifford Potter, of Newton, Mass., who, it is understood, represents the Colonial Securities Company and others holding bonds of the Rockingham Power Company. The consideration is said to be about $750,000. It is approximated that $2,000,000 has been spent on the Blewitt Falls plant, which was recently bid in by the above-named. The deed probated for the plant is made by Franklin Q. Brown, Edwin F. Green, C. W. Mason and others acting as a reorganization committee. The resident engineer has declared that it is his understanding that work on the plant will be resumed as soon as possible. L.

ELECTRIC RAILWAYS.

(Special Correspondence.)

SPRINGFIELD, ILL.—The Southern Street Railway Company of Chicago has certified to an increase in capital from $800,000 to $2,400,000. Z.

FOWLER, COLO.—The Pueblo & Suburban Traction & Lighting Company has applied for a franchise in this town. Current would come from Pueblo. P.

LOS ANGELES, CAL.—The Los Angeles Pacific Railroad Company has let a $250,000 contract for the construction of its electric line from Hollywood to Lankershirm.

GREEN BAY, WIS.—John A. Cusick has purchased from the Bay Shore Street Railway Company the electric traction line between this city and Bay View Beach. M.

MINNEAPOLIS, MINN.—The Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Company now has in operation forty miles of its line from the Washburn Park terminus to Northfield. Z.

GLENDALE, ARIZ.—S. H. Mitchell announces that the Glendale electric line will be constructed as soon as the rights of way are secured. Mr. Mitchell expects this to be before March of next year.

LAPORTE, IND.—The Chicago-New York Air Line Company has contracted with the Northern Indiana Gas & Electric Company to furnish power for the Laporte-Gary line for a period of ten years. S.

FRESNO, CAL.—F. S. Granger, of the Fresno-Hanford Interurban electric line, states that his company will soon invest $100,000 in the erecting and equipping of a power house to be built a little north of Fowler, ten miles southeast of Fresno.

NEWARK, N. J.—The Iowa Traction Company has been incorporated to construct railways. The capital of this concern is $2,000,000, and its incorporators are George E. Wodehouse, Oskaloosa; Jefferson C. Mabry, Albia; Irving T. Hunter, Newark, N. J.

SOUTH BEND, IND.—Samuel Murdock announces that the connecting link between the Northern Indiana and the Southern Michigan interurban lines will be constructed next Spring. This extension will require the building of an expensive bridge across the St. Joseph River. S.

BIRMINGHAM, ALA.—The Birmingham & Edgewood Electric Car Line has awarded to Furst, Wangler & Smith the contract for the completion of two and a half miles of track necessary to carry the line to the foot of Shades mountain, a short distance from Birmingham. Work will begin at once. I.

SPRINGFIELD, ILL.—The Illinois Traction System has pur-

chased of the Manning Engineering Company of Chicago a thirty-ton and a twenty-seven-ton electric crane to be used in wrecking work and other lifting purposes. The latter will be especially devoted to raising coal from the Company's submerged bins at Riverton and Mackinaw. Z.

PHOENIX, ARIZ.—The Board of Supervisors has granted to the Glendale Electric Company, which proposes to build an extension to the electric road of the Phoenix Street Railway Company, a franchise permitting it to build across certain public highways in this county. The company had already secured a private right of way except for the crossings.

BRUNSWICK, GA.—The St. Simonds Island Railway Company has been incorporated with $20,000 capital stock by Frank D. Aiken, A. Fendig, F. D. M. Strachan, J. B. Wright and others, of Brunswick, and M. Kiser, of New York City. The Company proposes constructing a trolley line or street car line of some sort on St. Simonds Island, near Brunswick. B.

CHAMPAIGN, ILL.—Congressman William B. McKinley, president of the Illinois Traction System, with George B. Duncan, of Portland, Me., and T. B. McCauley, of Montreal, Can., has bought the mule power street railway in Bridgetown, Barbadoes Island, a city of 25,000 persons, and will electrify it. Mr. McKinley will go to Barbadoes soon to look over the property. Z.

GREENVILLE, ILL.—The Commercial League has approved the plan of the recently incorporated Springfield & Central Illinois Traction Company to build an interurban line from Centralia through this city to Springfield. Sale of shares at one-fourth their par value to be treated as common stock has been made in towns along the line to raise a fund for the survey. Z.

MARION, O.—Notices have been sent out by the directors of the Columbus, Marion & Bucyrus Interurban line announcing that the property will be taken out of the hands of receivers George W. Whysall and Fred E. Guthery and placed in the hands of the stockholders. A stockholders meeting will be held on December 31, when the receivers will be discharged. H.

ATLANTA, GA.—The Georgia Railway & Electric Company, of Atlanta, has put in operation four new cars of the pay-as-you-enter type, which are said to be the precursors of a large number of other cars of the same nature. The new cars have obtained much in favor since they began operation, and the people of the city have expressed themselves as delighted with the new system. I.

TOLEDO, O.—Arrangements have been made whereby the Toledo Railways & Light Company will secure its current to operate the cars on the Maumee-Perrysville Belt line from the newly installed plant of the Maumee Valley Electric Company. This concern recently secured an entrance into the heart of Toledo by following the Miami & Erie Canal on state property. H.

LOGANSPORT, IND.—The County Commissioners have granted a franchise to the Logansport & Frankfort Traction Company, which proposes to construct and operate a traction line connecting the two cities and a number of intermediate towns. Some work was done on this route four years ago and abandoned. The new company is said to have ample means to build the road. The road will be about forty miles long and be an important link in trolley lines already built between Indianapolis and Hammond. S.

LAFAYETTE, IND.—The general accounts and financial management departments of the Murdock-Marshall Traction Syndicate have been transferred to this city. This includes the city lines of Evansville, Elkhart, Goshen, Laporte, Michigan City and South Bend and the Evansville & Southern Indiana, the Chicago, South Bend & Northern Indiana and the Southern Michigan Interurban lines. The change is made because Samuel Murdock and Henry W. Marshall, officers of the syndicate, live here. Local auditors will be maintained in each of the cities. Z.

MONTGOMERY, ALA.—The Alabama Traction Company, the new street railway which was incorporated a few weeks ago with a capital stock of $1,000,000, is considering the matter of purchasing trolleyless cars for its new line. These cars are in operation in Orange, N. J., and are to be given a trial in Atlanta, Ga. It is announced that the Company may order eight of these cars as a trial shipment, or for experimental purposes, and that the future orders of cars will depend upon the successful operation of the trolleyless variety. The surveying of the new line is rapidly nearing completion, and orders are being placed daily for supplies. It is announced that actual construction will be under way by January 1. I.

EAST ST. LOUIS, ILL.—Promoters of the Southern Traction Company, formerly the Indiana & Illinois Electric Company, were granted an extension of time to comply with the terms of the road's franchise upon promise to carry passengers from any part of East St. Louis over the new muncipal free bridge to the road's terminal in St. Louis for a five-cent fare. This is the fifth concession made since the company's charter was granted December 26, 1905. The promoters report that all grading in East St. Louis has been completed and they expect to have the line in operation within six months. Prominent in the company are President William E. Trautmann, United States district attorney of East St. Louis, former State Senator Henry C. Begole of Belleville and R. Vernon Clark. Z.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

SAVO, S. D.—The Savo Farmers' Telephone Company has been incorporated with a capital of $2,000. P.

FOREMAN, ARK.—The Foreman Telephone Company has been incorporated with a capital stock of $1,000. P.

LITCHFIELD, ILL.—The Carlinville Telephone Company, it is announced, will rebuild entirely its plant in this city. Z.

STERLING, ILL.—The Central Union Telephone Company is rebuilding its lines from Sterling to Rock Island, Moline, Davenport, Fulton and Dixon. Z.

COLFAX, IOWA.—The new building which will house the exchange of the Colfax Telephone Company is nearing completion. Lines in the business district have been laid underground. Z.

PARKER CITY, IND.—The Eastern Indiana Telephone Company, which operates and owns the exchange in Parker City, has been rebuilding the plant and new wires and cable lines will be strung. S.

CHRISMAN, ILL.—The Kinloch Telephone Company is building a new line between Chrisman and Tuscola. When this is completed the Company will have direct connections from Terre Haute, Ind., to Bloomington, Ill. Z.

DELAWARE, O.—The Ostrander Telephone Company of this city, has purchased the Citizens' Telephone Company's exchange. The exchange which has now been operated by the Citizen's Company at Warrensburg will be abandoned and the patrons connected with other nearby exchanges. The Ostrander Company has made no change in the rates. H.

CANTON, ILL.—The Canton Home Telephone Company has purchased a lot on North Main Street and upon it will erect a one and one-half story building of brick and stone to house its exchange. Perry P. Anderson is manager of the Company and M. J. Gorman, Lewis Thompson, E. A. Heald, G. M. Eyerly and W. D. and F. W. Plattenburg are directors. Z.

SULLIVAN, ILL.—Reconstruction and enlargement of the exchange is one of the plans of the Sullivan Home Telephone Company which recently was incorporated for $70,000 and which has a twenty-year franchise to operate here. Prominent in the company are C. B. Cheadle of Joliet, Ill.; A. G. Hawkins of Clinton, Iowa, and E. S. Sterrett of Henry, Ill. Z.

FT. WAYNE, IND.—The Home Telephone Company, now entering on its fifteenth year of successful operation, has elected the old board of directors and old officers, which include Charles S. Bash, president, and William L. Muellering, secretary. The Company has expended $71,000 for improvements during the last year. It has over 1,000 miles in toll lines and owns and operates exchanges in Kendallville, Auburn, Avilla, Rome City and New Haven. The Kendalville exchange has been rebuilt throughout and the other exchanges will be improved likewise during the next year. S.

ELECTRICAL SECURITIES.

The movement of the stock market during the past week has been very irregular with an alternate strengthening and weakening, so that in the end stocks showed very little change. There was some activity in the various specialties, but the market for issues of that class was largely manipulative and elicited practically no outside support. Trading throughout the week was of minor proportions, and, as has long been the case, of an ultra-professional character. Political events of the week, which included the new Supreme Court appointments, resumption of tariff legislation, suit by the Federal Government against the Southern Pacific Company, and threatened action from the same quarter against the so-called electrical trust, were without much influence.

The Southern Bell Telephone Company has sold to Kidder, Peabody & Company and N. W. Harris & Company jointly $10,000,000 five per cent bonds.

The annual meeting of the Interborough-Metropolitan Company will be held January 17. Preferred stock books closed December 22 and reopen January 18.

The following annual meeting dates have been announced: South Side Elevated, January 25; Oak Park Elevated, January 12.

The Calumet & South Chicago Railway has certified to increase in capital stock from $5,000,000 to $10,000,000, and Southern Street Railway from $800,000 to $2,400,000. They are suburban connections of Chicago City and connecting railways.

DIVIDENDS.

American Gas & Electric Company; preferred quarterly dividend of one and one-half per cent, payable February 1; common dividend of one and one-half per cent, payable January 2.

American Cities Railway & Light Company; common semi-annual dividend of two per cent; common extra of one-fourth of one per cent; preferred quarterly of one and one-half per cent, all payable January 2.

American Power & Light Company; regular quarterly dividend of one and one-half per cent on preferred, payable January 3 to stock of record December 20.

Bell Telephone Company of Canada; regular quarterly dividend of two per cent, payable January 14 to stock of record December 23.

Cities Service Company; initial dividends of one and one-half

per cent on the preferred stock and three-fourths of one per cent on the common, payable January 1 to stock of record December 20. Hereafter dividends on the preferred stock will be paid at the rate of one-half of one per cent a month, to stockholders of record on the twentieth of each preceding month.

Chicago City Railway Company; regular quarterly dividend of two and one-half per cent and an extra dividend of two per cent, payable December 30 to stock of record December 16. Books close December 17 and reopen December 23. These dividends make a total of 16 per cent for the fiscal year ending January 31, including an extra dividend of four per cent last March, as against a total of 9 per cent in the previous fiscal year, when the regular quarterly basis was one and one-half per cent and an extra of three per cent was paid.

Duluth-Edison Company; regular quarterly dividend of one and one-half per cent on the preferred stock, payable January 3 to stock of record December 20.

Manila Electric Railroad & Lighting Company; regular quarterly dividend of one per cent, payable December 31 to stock of record December 24.

Massachusetts Lighting Companies; dividend of one and three-fourths per cent, payable January 16 to stockholders of record December 31.

National Gas, Electric Light & Power Company; script dividend of twenty-one per cent in full payment of all accumulated and accrued dividends on the preferred stock to January 1, 1911. It is expected that dividends on the shares will hereafter be paid in cash and distribution will be made quarterly instead of semiannually.

Norfolk & Portsmouth Traction Company; quarterly dividend of one and one-fourth per cent, payable January 10, to stock of record December 28.

Northwestern Elevated, Chicago; preferred quarterly dividend of one per cent, payable January 18.

Otis Elevator Company; regular quarterly dividend of one and one-half per cent on the preferred stock, payable January 16 to stock of record December 31.

Public Securities Company; semiannual dividend of three and one-half per cent on outstanding preferred stock, payable January 1 to stock of record December 31.

Reading Traction Company; semiannual dividend of seventy-five cents per share, payable January 1 to stock of record December 19.

United Gas Improvement Company; regular quarterly dividend of two per cent, payable January 14 to stock of record December 31.

Virginia Railway & Power Company; preferred semiannual dividend of two and one-half per cent, payable January 5.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Dec. 19.	Dec. 12.
Allis-Chalmers common	8⅜	8⅛
Allis-Chalmers preferred	27½	28½
Amalgamated Copper	63⅞	64⅝
American Tel. & Cable	*78	78
American Tel. & Tel.	141½	141½
Brooklyn Rapid Transit	74¼	74⅛
General Electric	155⅛	154
Interborough-Metropolitan common	20½	19½
Interborough-Metropolitan preferred	55⅞	54
Kings County Electric	123	123
Mackay Companies (Postal Telegraph and Cables) common	89	87¾
Mackay Companies (Postal Telegraph and Cables) preferred	74½	74
Manhattan Elevated	138	138
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	44	43⅝
U. S. Steel common	72¾	73⅝
U. S. Steel preferred	116¼	116
Western Union	73¾	71
Westinghouse common	66¼	67
Westinghouse preferred	113	120

*Last price quoted.

BOSTON.

	Dec. 19.	Dec. 12.
American Tel. & Tel.	141⅞	141½
Edison Elec. Illuminating	281	280
General Electric	155	154
Massachusetts Electric common	18	18¼
Massachusetts Electric preferred	85	84¼
New England Telephone	138	138
Western Tel. & Tel. common	16	16
Western Tel. & Tel. preferred	86	86

PHILADELPHIA.

	Dec. 19.	Dec. 12.
American Railways	42⅝	42¾
Electric Company of America	11⅝	11⅝
Electric Storage Battery common	49	48
Electric Storage Battery preferred	49	48
Philadelphia Electric	15⅞	15⅝
Philadelphia Rapid Transit	18¾	18½
Philadelphia Traction	83	83
Union Traction	43½	42¾

CHICAGO.

	Dec. 19.	Dec. 12.
Chicago Railways, Series 1	90	90½
Chicago Railways, Series 2	23	22¾
Chicago Subway	4	4
Chicago Telephone	122	122½
Comomnwealth Edison	115	115
Metropolitan Elevated common	20	20
Metropolitan Elevated preferred	65	65
National Carbon common	120	120
National Carbon preferred	118	118

PERSONAL MENTION.

ALEXANDER GRAHAM BELL has been elected an honorary member of the Royal Institution of Great Britain.

SAMUEL INSULL, president of the Commonwealth Edison Company, Chicago, will spend Christmas in England.

FRANK ARMSTRONG, of Galena, Ill., has been appointed manager of the exchange of the Central Union Telephone Company at Sterling, Ill.

J. S. MALTMAN, manager of the Kankakee Electric Light Company, Kankakee, Ill., has resigned to accept the position of electrical engineer for the Robertson Engineering Company, of Baltimore, Md.

THEODORE N. VAIL is the subject of an anecdote in the current issue of *Harper's Weekly*. The story is taken from Casson's "History of the Telephone" and refers to his first offer of a position with Gardiner G. Hubbard.

THOMAS STURGESS has been appointed business manager of the Vandalia Telephone Company, with the principal office at Vandalia, Ill. The Company has branches at Shobonier, Brownstown, Vernon, Traxler and Pittsburg, Ill.

H. F. THURBER, vice-president and general manager of the New York Telephone Company, gave an address before the meeting of the Telephone Society of New York, on December 19. The subject on which Mr. Thurber spoke was "Our Business Associates."

CHARLES L. PILLSBURY, consulting mechanical and electrical engineer, of 805 Metropolitan Life Building, Minneapolis, Minn., has been visiting in New York City, where he was entertained by Capt. W. L. Candee of the Okonite Company. Mr. Pillsbury is consulting engineer of the Minneasota State Board of Control.

H. B. SHAW, Dean of the School of Engineering, University of Missouri, has been retained as consulting engineer by the city of Columbia, Mo. Associated in the work with Professor Shaw is H. H. Humphrey, the well-known engineer of St. Louis. The city of Columbia has sold bonds amounting to $125,000 for the new electric light and waterworks plant and work will be started at once.

A. P. MUNNING, general sales manager of the Cutler-Hammer Manufacturing Company, who makes his headquarters at New York, was in Chicago last week on a hurried trip to the West. Mr. Munning recently returned from a two months' trip to Europe, taken for the purpose of "resting up," but his active nature rebelled and it is said the large Cutler-Hammer interests abroad received a good deal of his attention.

JOHN M. HANCOCK, of Niagara Falls, N. Y., has been appointed industrial agent of the Cliff Electrical Distributing Company of that city. His work will be in connection with the development of industries which will use electric power distributed by the Cliff Company. Mr. Hancock is a former mayor of Niagara Falls and is well acquainted with the Niagara power development situation. He will take up his new duties on January 1.

FRANK KOESTER is preparing for the press a book on the use of electric energy for various operations on farms, with the idea of supplanting a great deal of the need for farm hands. Mr. Koester is already well known for his publications, some of which have been adopted as text books in universities. Mr. Koester received his training in Germany, where he spent four years at a technical school, three years in shop and field experience, and four years in general engineering work. He has devoted a great deal of time to the design and construction of power plants in Norway, Germany, Austria, Japan and America. In 1902 Mr. Koester came to the United States and was engaged in the engineering work of the Interborough Rapid Transit Company. Upon leaving this he became associated with a firm of consulting engineers in New York, and has designed a large number of power plants. He also worked on the project for the heating system of the Government buildings in Washington, D. C., and in connection with this enterprise he made in 1906 a report on modern European heating systems, using superheated steam in the transmission piping. With his wide experience in power-plant practice and the study of power-plant economics he has been called upon to make a number of tests and reports of isolated plants and central-station systems. One of the latest of these is for the Consolidated Gas, Electric Light & Power Company of Baltimore, in which he pointed out a yearly saving of $50,000 in the running expenses. Mr. Koester takes a wide inter-

FRANK KOESTER.

est in electrical engineering problems and is the author of numerous papers in the technical press and before engineering societies.

O. R. M. HEMMING, formerly assistant superintendent and electrical engineer of the Ohio & Southern Traction Company, has been appointed general manager of that company. Mr. Hemming has been engaged in contracting and construction work for nearly twenty years and now returns to the Ohio Southern as general manager.

A. J. McGIVERN, well known as general manager of the Metropolitan Electrical Supply Company, Chicago, Ill., has recently severed his connection with the Company and accepted a position with the Manhattan Electrical Supply Company of Chicago. Mr. McGivern, who was connected with the former company for a period of twelve years, will assume the position of sales manager of the supply department for the Manhattan Company.

L. C. SHIPHERD was appointed as general superintendent of the Evansville & Southern Indiana Traction Company to succeed F. M. Durbin, who resigned. Mr. Shipherd has been in the employ of the Evansville & Southern Indiana Traction Company and its predecessor, the Evansville Electric Railway Company, for eleven years, having previously been employed on the St. Louis Suburban road. As general superintendent of the Evansville & Southern Company he will have jurisdiction over all lines of the system.

R. L. JAYNES, of Pittsburgh, Pa., has been appointed Jovian Statesman for Pennsylvania. Mr. Jaynes is one of the most energetic and popular men in the electrical fraternity and has a host of friends all over the country. He is the sales representative of the American Conduit Manufacturing Company, Hart Manufacturing Company and the Bossert Company. In addition to his activity in electrical circles Mr. Jaynes is the owner of a herd of prize cattle, and finds his recreation on his well appointed stock farm in Fredericksburg, Va.

CYRUS O. BAKER, the well-known platinum importer and refiner, and a director of the National State Bank, of Newark, N. J., presided at the reunion at the Hotel Astor, New York City, on Friday evening of last week, of the Pennsylvania Bankers' Special to the convention of the American Bankers' Association, held in Los Angeles, Cal., in October last. There were about eighty present, all of whom had been travelers on the luxurious special train to Los Angeles. Mr. Baker spoke wittily and interestingly of the tour and of the value of the reunion, and, as toastmaster, introduced the several eloquent speakers who followed him. The occasion proved a most delightful one and will probably be repeated.

LEGAL NOTES.

COUNTY AUTHORITIES' POWER TO INSTALL TELEPHONES.—The Court of Appeals of Georgia says that the county authorities in that state have the power to install telephones or to cause them to be installed in the courthouses, jails, pauper farms and other places where they may be needed in the conduct of such matters and things as the counties are authorized to support and maintain by taxation. Telephone service is no longer a luxury. It is a modern business necessity. When it is needed in connection with the matters and things which the county authorities are authorized to maintain and to tax for they may lawfully contract for it. It then becomes a part of the maintenance and equipment of the public buildings, a part of the expense of courts, of prisoners, of paupers, etc. It becomes a part of the machinery by which the county authorities carry on the legitimate county business; and the authorities may lawfully pay for it out of the county funds.—Wood vs. Vienna Telephone Company, 68 S. E. 872.

POWER TO ESTABLISH RULES AND REGULATIONS.—It will not be doubted that a telephone company has the power to establish rules and regulations for the operation and conduct of its business in a given territory when such rules and regulations are reasonable in their requirements, and not in conflict with any provision of general law, or any special provision of the franchise under which it obtains and exercises its rights in the territory. Telephone companies being public service corporations, are charged with certain public duties, which they may not refuse, and any rule or regulation which falls within the character above referred to which is reasonably proper and necessary to enable them to fulfill and discharge these public duties and render the public efficient service will be enforced. A rule requiring the payment of its monthly rentals in advance is a regulation of the permitted character, and so is the further regulation that, unless the service is paid for in advance, it may be denied, as also is a rule providing for an additional charge in case such requirement is not complied with. Such a charge is not an addition to the maximum rate provided for in the franchise. It is rather a charge for default and delinquency, which may be avoided by a compliance with the reasonable regulation for the payment of rentals in advance. The company being bound to render the public efficient service, it has the right to enforce such rules as will provide for the prompt payment of its rentals, and thus provide for the securing of funds with which it may insure and protect the efficiency of its plant and keep it at such a standard as will enable it to discharge its public duties when called upon to do so, either voluntarily at the request of the individual, or involuntarily at the command of the courts.—Supreme Court of Washington in State vs. Independent Telephone Company, 109 Pac. 366.

NEW PUBLICATIONS.

THE COKE INDUSTRY OF THE UNITED STATES.—This bulletin, prepared by Richard Moldenke and issued by the Bureau of Mines, treats of the method of making coke, its uses and the proper methods of use in connection with the foundry.

GYPSUM AS A FIREPROOF MATERIAL.—Under this title the American Society of Civil Engineers has published a report prepared by H. G. Perring, of tests which have been made with gypsum plaster, and plastered board. Several tables show the temperatures and duration of the tests which were made.

WHAT ARE SPECIAL LIBRARIES?—Louis B. Krause, Librarian, H. M. Byllesby & Company, Chicago, presented a paper under this title at a meeting of the Illinois Library Association. The paper which has been abstracted and printed in the form of a booklet, deals with the requirements of an engineering firm in regard to its special literature.

AN APPRECIATION OF THOMAS DAVENPORT.—The meeting of the Vermont Electrical Association and New England Section of the National Electric Light Association observed on September 28 the anniversary of the birth of Thomas Davenport and unveiled a tablet which had been erected in his honor at Forrestdale, Vt., near Brandon. The publication, which was prepared by T. Commerford Martin, deals with the life and work of this inventor. It is in the nature of a souvenir of the unveiling of the Davenport tablet.

LEGISLATION UPON INDUSTRIAL EDUCATION.—The National Society for the Promotion of Industrial Education has recently issued Bulletin No. 12, entitled "Legislation upon Industrial Education in the United States." The book is divided into five parts, the first of which is a reprint, with a few slight changes, of the first section of a pamphlet issued in 1909 by the American Association for Labor Legislation, prepared by Dr. Edward C. Elliott, of the University of Wisconsin. This part of the book gives a general summary of the "Legislation Relative to Industrial Education in our Public Elementary and Secondary Schools." The remainder of the book was prepared especially for the National Society by C. A. Prosser, deputy commissioner of education for the state of Massachusetts. After proposing a more definite nomenclature for the subject, Mr. Prosser has traced out the trend of legislation, giving an analysis of the legislation in Massachusetts, New York, Connecticut, Wisconsin and New Jersey.

PROPOSALS.

ELECTRIC FANS.—Sealed proposals will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, until December 28, for twelve Type "E" direct-current electric fans, equal to No. 38725, National Electric Supply Company catalogue.

ASSAY OFFICE, NEW YORK CITY.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until January 3 for the installation of a conduit and electric wiring system in the United States assay office, New York, N. Y., in accordance with drawings and specifications, copies of which may be had at the office of the superintendent of construction, New York, N. Y., or at the Supervising Architect's office.

POST OFFICE, BATH, ME.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until January 16 for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus, and electric conduits and wiring system of the United States post office and custom house at Bath, Me., in accordance with drawings and specifications, copies of which may be obtained from the custodian at Bath, Me., or at the Supervising Architect's office.

LIGHTING FIXTURES, ALBANY, N. Y.—Sealed proposals will be received by the secretary of the State Trustees of Public Buildings, State Capitol, Albany, N. Y., until noon January 24, for the installation of electric lighting fixtures for the new State Education Building at Albany, N. Y., and for electric wiring for book stacks, book cases and extension to existing plant. The drawings and specifications, the form of contract, the bond and blank forms for proposals, may be obtained at the office of the architects, Palmer & Hornbostel, 63 William street, New York City. One set of drawings, specifications, etc., will be furnished contractors intending to submit proposals for the items of work, on application to the architects and upon the payment of a deposit of $50. Contractors submitting proposals for electric lighting fixtures are required to deliver certain sample fixtures at the Albany office of the architects, at the corner of Washington Avenue and Hawk Street, at or before the time fixed for the receipt of the proposals.

NEW INCORPORATIONS.

DES MOINES, IOWA.—The Peterson-Retrum Battery Company was recently incorporated by H. L. Peterson, J. M. Peterson and A. O. Retrum. The capital stock of the company is $50,000.

COLUMBUS, O.—The Columbus Electric Manufacturing Company has been incorporated with a capital of $125,000 for the purpose of manufacturing electric scales. The incorporators are Walter Smith, Walter Felton, George W. Wofel, James M. Davis and Everett Taylor.

INDUSTRIAL ITEMS.

THE SAMPSON CORDAGE WORKS, Boston, Mass., is mailing to the trade a desk calendar advertising Sampson spot cord.

CHAS. E. MILLER, New York, N. Y., dealer in automobile supplies, has issued his advance catalog for 1911. A full line of parts and accessories is listed.

WICKES BROTHERS, Saginaw, Mich., list in their December monthly stock list of machinery bargains an extensive line of boilers, engines, pumps, machine tools, electrical machinery, etc.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., describes and illustrates "Junior" battery switches and combination switches in iron boxes, in the December number of *Trumbull Cheer*.

ALLIS-CHALMERS COMPANY, Milwaukee, Wis., is mailing to the trade Bulletin No. 1501, in which the Allis-Chalmers belted Corliss engines are described and illustrated. The engines shown in this publication are of the "Reliance" pattern.

THE ELECTRIC SHOP, Chicago, Ill., has issued a booklet advertising its electrical goods, toys and devices, with especial reference to the Christmas trade. A number of illustrations are used to show the various styles of lamps, chafing dishes, etc.

DEAN BROTHERS STEAM PUMP WORKS, Indianapolis, Ind., has issued Catalog No. 83, on special boiler feeders or pressure pumps. The catalog is well illustrated and contains descriptions of a number of different types of the Company's pumps.

WILLIAM MARSHALL, 709 Lexington Avenue, New York, N. Y., supplies condensers for telegraph, telephone, wireless and various other purposes. He also makes a specialty of standard condensers. Mr. Marshall has been in the electrical business for thirty-five years.

THE HUGHES ELECTRIC HEATING COMPANY, Chicago, Ill., is mailing to the trade booklets descriptive of the Hughes Electric cook stove. A statement made in this publication is that "A 1910 Electric Range with its multitude of advantages, costs much less to operate than an 1880 Coal Range."

THE HARTMAN ELECTRICAL MANUFACTURING COMPANY, Mansfield, O., describes in a recent publication the Hartman electric lighting system for automobiles and motor boats. Illustrations show the appearance and method of installation of the generator, and a diagram is used to make clear the scheme of wiring.

THE SUNBEAM INCANDESCENT LAMP COMPANY, Chicago, Ill., has recently issued a number of booklets on the Sunbeam Mazda lamp. One of these, entitled "How to Figure Illumination," contains a number of valuable suggestions on this subject and also lists and illustrates Sunbeam Mazda lamps. These lamps are distributed by the Western Electric Company.

PETTINGELL-ANDREWS COMPANY, Boston, Mass., illustrates in the December issue of *Juice* a line of holiday goods and portable lamps. Articles on the new Opalux reflector, Fort Wayne meters and Clayton & Lambert Torches and Fire Pots show new or seasonable goods. The fifth of a series of wiring tables and the first number of an article on industrial lighting occur in this number.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., has prepared a very attractive booklet on the electric vehicle and the Westinghouse controller and vehicle motor. The booklet, which contains short selling arguments and attractive illustrations, is being furnished to central station companies in order to promote through them the use of the electric vehicle.

THE FEDERAL ELECTRIC COMPANY, Chicago, Ill., describes in the December number of *The Federalist*, the electrical equipment of the High-School Building at San Jose, Cal. One of the most interesting items regarding this equipment is the experimental switchboard, which is constructed with a glass front and back. This is said to be the only switchboard of this character which has ever been constructed.

THE BALL & WOOD COMPANY, Elizabethport, N. J., announces in a recently issued catalog that in addition to building Rateau-Smoot turbines of the high and low-pressure types, it is also building these turbines, which are of the impulse type, for mixed-flow pressure. The new type consists of a straight low-pressure turbine with supplementary wheels to use economically high-pressure steam by means of an automatically controlled governor.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, O., is distributing bulletins entitled "Automobile Lighting by Electricity." The suggestions made in the bulletin are along the lines of modern practice in wiring, their object being to enable the automobile manufacturer to wire his cars in the most approved manner. The publication is illustrated with reproductions of photographs and also contains a number of diagrams showing the best wiring arrangement.

THE AMERICAN ELECTRIC FUSE COMPANY, Muskegon, Mich., announces that its Chicago office, with Fred D. Bonde in charge, is now located at No. 900 Vogue Building, No. 290 Fifth Avenue. Mr. Bonde was recently transferred to the Chicago office from the St. Paul district. He will carry, at the new location, a complete sample line of Blue Ribbon telephone protectors, "Allen-Bradley" motor starters, controllers and battery-charging rheostats, American enameled magnet wire, and American ignition apparatus.

THE HERRICK ENGINE COMPANY, New York, N. Y., announces in a recent folder the success of recent tests which were made with a 100-horsepower balanced rotary engine. This single cylinder engine was tested in the laboratory of Stevens Institute, with 106 pounds steam pressure at the throttle, running at 816 revolutions per minute, and exhausting into the atmosphere. Under these conditions it developed 104.8 brake horsepower, showing at that time a consumption of 39.6 pounds of steam per brake-horsepower per hour.

THE NATIONAL X-RAY REFLECTOR COMPANY, of Chicago, will move its general offices and display salesrooms about January 1 to the ground-floor store in the new Brooks Building at the southeast corner of Jackson Boulevard and Franklin Street. This removal is necessitated by the greatly increased business of the Company and the new quarters are being finely fitted up so as to permit the Company to demonstrate to better advantage its "Eye-Comfort" system of indirect illumination and its various types of window reflectors. An array of interesting bulletins on the Company's lighting specialties will be available for distribution. These describe some of the numerous and notably successful installations made and the possibilities for effective and restful illumination by using the Company's equipment.

THE GENERAL ELECTRIC COMPANY has recently issued Bulletin No. 4790, on electric mine locomotives, which supersedes its previous bulletin on the same subject. This bulletin illustrates and describes in considerable detail two and three-motor mine locomotives of various capacities, arranged to operate either singly or in tandem. The bulletin describes also the Company's gathering locomotive, which consists of any one of its standard locomotives equipped with a motor-operated reel, to which is attached flexible heavy insulated cable. This publication also describes the various devices, such as controllers, fuse blocks, headlights, etc., with which the locomotives are equipped. Bulletin No. 4794 describes the 1,200-volt lines of the Milwaukee Electric Railway & Light Company. This is a reprint of an article which appeared in the *Electric Railway Journal*. In Bulletin No. 4662-A are described the Company's watt-hour meters for switchboard service.

DATES AHEAD.

American Association for the Advancement of Science, and affiliated societies. Minneapolis, Minn., December 27-31.

Chicago Electric Show. Coliseum, Chicago, Ill., January 7-21.

Indiana Engineering Society. Annual meeting, Indianapolis, Ind., January 12, 13 and 14.

Electrical Contractors' Association of New York State. Annual meeting, Albany, N. Y., January 16.

Minneapolis Electrical Show. Minneapolis, Minn., January 26-Feb. 4.

Iowa Electrical Association. Annual meeting, Davenport, Iowa, April 19, 20 and 21.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) December 13, 1910.

978,128. TELAUTOGRAPH. Ralph W. Armstrong, New York, N. Y., assignor to Gray National Telautograph Company, New York, N. Y. Filed November 16, 1906. Is provided with a pivotally supported snap switch, in one position of which the receiver is "on" and the transmitter "off" with respect to the distant station and in the other position of which this condition is reversed.

978,130. ADVERTISING DEVICE. Thomas H. Barron, New York, N. Y. Filed April 1, 1907. An endless belt carries a row of incandescent lamps connected to a circuit and is moved around a window or opening by an electric motor. A casing incloses all parts except the lamp bulbs.

978,137. APPARATUS FOR ELECTRIC SMELTING. Frank Creelman, New York, N. Y., assignor to Willson Carbide Works Company of St. Catherines, Limited, St. Catherines, Canada. Filed January 7, 1904. A constant-current arc furnace is constructed to maintain a fusion zone in an opening and is equipped with a device to withdraw the fused product progressively as it is formed and at a rate varying with the arc voltage.

978,146. ELECTRIC FURNACE. Charles Fery and Charles Langlet, Paris, France. Filed January 30, 1907. A resistance furnace has a resistance coil surrounding its heating chamber, a longitudinally extensible jacket about the coil and protecting filling between the coil and jacket.

978,147. OSCILLATING ELECTRIC FAN. Herbert I. Finch, St. Louis, Mo., assignor to Emerson Electric Manufacturing Company, St. Louis, Mo. Filed July 6, 1910. The armature is mounted on a hollow sleeve and a rod passes through the sleeve and connects the fan to the oscillating means.

978,160. ELECTRIC CHAIN-WELDING MACHINE. Carlton L. Hoff, York, Pa., assignor to Standard Chain Company, York, Pa. Filed November 20, 1908. Gripping jaws for the link are movable bodily toward and from the electrodes and pivotally mounted on an axis to swing transversely, whereby the end of the link may be centered between the electrodes.

978,163. ELECTRIC-LIGHTING FIXTURE. Lemuel R. Hopton, Plainfield, N. J., assignor to Enos Company, New York, N. Y. Filed March 1, 1910. An electric-candle fixture consists of a candle cup, a retainer yoke within the same, a candle tube and a switch within the yoke.

978,171. ELECTRIC FURNACE. Franz von Kügelgen, Holcombs Rock, Va., and George O. Seward, East Orange, N. J., assignors to Virginia Laboratory Company, New York, N. Y. Filed December 18, 1907. A reverberatory furnace has a closed top and non-conducting lining adapted to inclose and retain a substantially inert gaseous body of sufficient thickness to protect the lining beyond it from fusion.

978,173. ELECTRIC MOTOR-CONTROLLING APPARATUS. Harry Ward Leonard, Bronxville, N. Y. Filed January 23, 1905. Renewed February 20, 1907. A starter and speed controller is provided with overload and no-load release coils and a device to prevent starting the motor except with the contact arm of the field rheostat on the no-resistance point, thus preventing a weak starting field.

978,180. RAILWAY SIGNALING SYSTEM. Alonzo C. Mather, Chicago, Ill. Filed July 3, 1907. Includes a third rail midway between the main rail and contact wheels for this and the main rails.

978,197. ELECTRIC IGNITION APPARATUS. Harry G. Osburn, Detroit, Mich. Filed October 1, 1908. A timing device has an induction coil and circuit-breaker associated with it.

978,199. PLUG FOR ELECTRICAL CONDUCTORS. James W. Phelps, Detroit, Mich. Filed December 2, 1908. The terminals of the cord are secured in hollow chambers on opposite sides of the central insulating web.

978,211. ART OF EXTRACTING METALS ELECTROLYTICALLY. James Hart Robertson, New York, N. Y. Filed June 20, 1908. Renewed May 5, 1910. Consists in simultaneously subjecting the powdered ore, while in suspension in an electrolyte, to the combined action of a heated vapor or gas while in motion, and an electric current.

978,272. PNEUMATIC-DESPATCH-TUBE APPARATUS. James T. Cowley, Boston, Mass., assignor to Lamson Consolidated Store Service Company, Newark, N. J. Filed May 11, 1908. Includes an electromagnetically controlled air valve.

978,280. REMOVABLE SPARK-PLUG. Wray Falwell, Boston, Mass., assignor to Wray Manufacturing Company. Filed December 6, 1909. A metallic shell electrode is arranged so it may be removed.

978,322. COMBINED SWITCH SOCKET AND PLUG. William Pinkney McNeel, San Antonio, Tex. Filed August 9, 1910. The plug and socket are made of one piece to which is attached a pendant push-button switch.

978,370. TELEPHONE-RECEIVER SUPPORT. Joseph G. Harris and Anthony Mancuso, Philadelphia, Pa. Filed September 5, 1908. Clamped to a desk telephone stand is a bracket for holding the receiver to the ear. Moving the receiver-support forward raises the switch-hook.

978,377. ELEVATOR. Henry A. Humphrey, Kansas City, Mo., assignor to Safety Elevator Lock & Signal Company, Kansas City, Mo. Filed June 7, 1910. An electric elevator is provided with gate-locking means which prevent the hoisting motor from being started while any of the gates are open.

978,388. ELECTRIC-LIGHTING APPARATUS. James F. McElroy, Albany, N. Y., assignor to United States Light & Heating Company, New York, N. Y. Filed May 3, 1905. An axle-driven car-lighting outfit is provided with means whereby the potential at which the generator is connected to the lights and battery may be adjusted at will.

978,418. ELECTRICAL SPOT-WELDING MACHINE. William C. Winfield, Warren, Ohio, assignor to Winfield Electric Welding Company, Warren, Ohio. Filed October 8, 1909. Adjustable supports are provided for the two welding contacts.

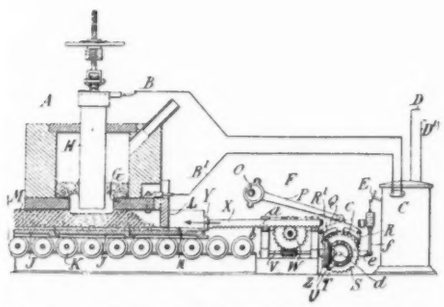
978,435. TELEGRAPH-TRANSMITTER APPARATUS. Harry G. Davis, Williamsport, Pa., assignor to Electric Press Bulletin Company, Williamsport, Pa. Filed October 18, 1909. A printing telegraph instrument.

978,448. APPARATUS FOR TREATING METALS. George A. Goodson, Minneapolis, Minn. Filed February 10, 1908. Combines with a melting pot and circulating connections of small bore outside the pot through which the molten metal may be passed by a pump and means for subjecting the molten metal to an electric current while passing through the circulating connections.

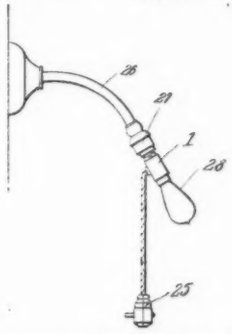
978,464 and 978,465. ELECTROMETALLURGICAL FURNACE. Francois Douvrier, Mexico, Mexico. Filed November 23, 1908, and December 18, 1909. A series of reducing chambers and one or more refining chambers are each provided with separately controlled current supply.

978,483. CASING FOR INCANDESCENT-LAMP SOCKETS. Clarence D. Platt, Bridgeport, Conn. Filed January 24, 1910. Relates to means for locking the cap and shell.

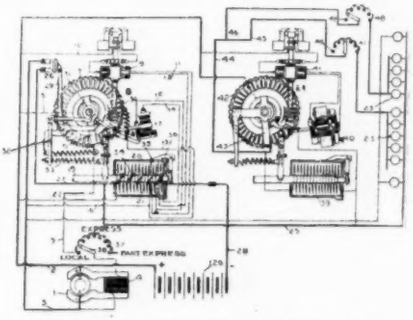
978,494. SPARK-PLUG FOR INTERNAL-COMBUSTION ENGINES.



978,137.—CONTINUOUS ELECTRIC FURNACE.



978,322.—COMBINED SWITCH SOCKET AND PLUG.



978,388.—CAR-LIGHTING REGULATOR.

978,513 and 978,514. SYSTEM OF ELECTRICAL DISTRIBUTION. Joseph H. Tracy, Philadelphia, Pa. Filed January 10, 1908, and April 22, 1909. The first of these patents relates to the regulation of a pair of boosters used in connection with a storage battery on a three-wire system. The second patent covers means for limiting the current flowing to or from the battery.

978,518. ELECTRICAL MEASURING INSTRUMENT. Thomas W. Varley, New York, N. Y., assignor to Westinghouse Electric & Manufacturing Company. Filed June 12, 1908. Has a permanent magnet, a coil adapted to shift its field and an armature responding to the distortion of the field.

978,532. CANOPY FOR GAS AND ELECTRIC-LIGHT FIXTURES. Lauritz W. Andersen, Waterbury, Conn., assignor to Plume & Atwood Manufacturing Company, Waterbury, Conn. Filed September 14, 1910. Relates to the manner of securing the canopy on the tube.

978,583. APPARATUS FOR USE IN RECLAIMING VULCANIZED-RUBBER WASTE. Charles S. Heller, Barberton, Ohio, assignor to Moore Architectural & Engineering Company, Akron, Ohio. Filed February 25, 1910. The reclaiming solution is forced between the terminals of an electric circuit.

978,584. PROCESS FOR RECLAIMING VULCANIZED-RUBBER WASTE. Charles S. Heller, Barberton, Ohio, assignor to Moore Architectural & Engineering Company, Akron, Ohio. Filed February 25, 1910. The pulverized rubber waste is treated with a solution of caustic alkali and ferric sulphate, which solution is then subjected to heat and the action of an electric current.

978,593. ELECTRIC TIME SIGNAL. John Isaac Johnston, Graham, Mo. Filed May 10, 1910. An electric alarm clock.

978,603. TESTING SYSTEM FOR PARTY-LINES. Dwight A. Lawver and Clifford C. Bradbury, Chicago, Ill., assignors to Kellogg Switchboard & Supply Company, Chicago, Ill. Filed James E. Seeley, Los Angeles, Cal., assignor to High Frequency Ignition Coil Company, Los Angeles, Cal. Filed November 26, 1909. An air gap is provided around the insulation between the inner and outer electrodes.

December 17, 1908. A busy-test arrangement provides a special tone in the operator's receiver when the called line is in use.

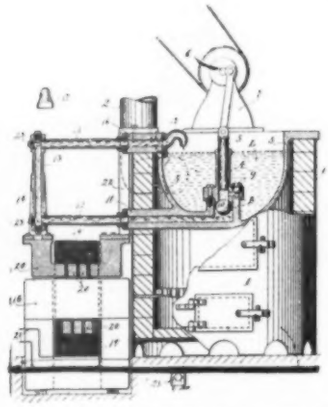
978,604. ELECTRICAL TUNING DEVICE. Robert H. Marriott, Brooklyn, N. Y., assignor to United Wireless Telegraph Company. Filed November 13, 1908, July 7 and August 24, 1909. Relates to means for adjusting the inductance and capacity of a wireless system. The first and third patents cover an arrangement of two adjustable subdivided induction coils; the second covers an adjustable condenser.

978,607. PROTECTION APPARATUS FOR DYNAMO-ELECTRIC MACHINES. Robert H. Marriott, Brooklyn, N. Y., assignor to United Wireless Telegraph Company. Filed Nov. 27, 1909. The frame of the motor driving the high-frequency generator is connected to one side of a condenser and the armature rheostat of the motor is connected to the other side of the condenser.

978,608. ELECTRIC CONNECTIONS FOR CARRIAGE LAMPS. Charles O. Mathews, Milford, Conn., assignor of one-half to White Manufacturing Company, Bridgeport, Conn. Filed March 2, 1910. The two wires are connected through a block at the base of the lamp.

978,629. AUTOMATIC ELECTRICAL SIGNALING SYSTEM. James G. Nolen, Chicago, Ill. Filed February 26, 1904. The motor signal box contains electrically controlled clockwork.

978,630. CONDUCTOR-SPLICER. Frederick William Oettgen, New York, N. Y. Filed May 3, 1910. A helically-wound spring member through which the wire is adapted to pass has alternate convolutions constructed to pass under the adjacent convolutions when the member is subjected to end compression.



978,448.—ELECTRICAL TREATMENT OF METALS.

978,636. METER-CONNECTION BLOCK. Granville E. Palmer, Winchester, Mass. Filed June 6, 1910. An insulating block has mounted on it a number of terminals for the series circuit of the meter and for the line and service terminal.

978,638. REGULATION OF DYNAMO-ELECTRIC MACHINERY. Charles Algernon Parsons and Alexander Henry Law, Newcastle-upon-Tyne, England; said Law assignor to said Parsons. Filed May 15, 1908. Provides means for supplying alternating current of different phases to a magnetic shunt between the main poles of a polyphase generator.

978,675. SAFETY DEVICE FOR METAL MIXERS. Max M. Suppes, Elyria, Ohio. Filed July 27, 1910. A solenoid is arranged to disengage a pawl that holds the cylinder from rotating.

978,676. PROTECTIVE SAFETY DEVICE FOR ELECTRICAL CIRCUITS. William F. Swoveland, Altoona, Pa. Filed October 16, 1908. A high-tension and a low-tension circuit cross, the former having an overload circuit breaker and the latter a grounding switch.

978,678. ELECTRICALLY-OPERATED APPARATUS FOR DISCHARGING LIQUIDS FOR FLUSHING OR OTHER PURPOSES. William Henry Thompson and Robert Thompson, London, England. Filed February 7, 1910. The rise and fall of liquid in the cistern controls an electrically operated valve.

978,695. SIGNALING APPARATUS. George H. Caughrean, Ketchikan, Alaska, assignor of one-sixth to Addis J. Dunton and one-sixth to Harry T. Dobson, Ketchikan, Alaska. Filed January 3, 1910. A telephone receiver and transmitter are adapted to react on each other to produce a singing sound as a signal at the called station.

978,706. VALVE. James E. Davidson, Butte, Mont. Filed July 23, 1910. A solenoid controls the valve stem through a pawl and ratchet.

978,709. COMBINED TELEPHONE AND ALARM OR KINDRED SERVICE SYSTEM. William W. Dean, Chicago, Ill., assignor to Consolidated Fire Alarm Company, New York, N. Y. Filed April 30, 1903. A set of relays control means for receiving distinctive signaling currents.

978,728. APPARATUS FOR THE ADMINISTRATION OF GENERAL ANESTHETICS. Carroll H. Frank, Jacksonville, Fla. Filed May 25, 1909. Electrical means governed by the exhalation of the patient open a valve and close it when the exhalation ceases.

978,733. ANSWER-BACK SIGNAL. Edwin R. Gill, Yonkers, N. Y., assignor to United States Electric Company. Filed July 27, 1907. Two answer-back signals are inductively related to the local signal.

978,774. COIN-OPERATED TELEPHONE APPARATUS. David Pratt Meade, White Post, Va. Filed July 29, 1910. A prepayment telephone.

978,786. OZONIZER. Ralph D. Small, Chicago, Ill., assignor to Standard Electro-Utilities Company, Chicago, Ill. Filed September 23, 1910. A stationary dielectric has a stationary electrode on one side thereof and a continuously rotatable perforated electrode on the other side.

978,805. SWITCH MECHANISM. Charles D. Wiemer, Los Angeles, Cal. Filed May 9, 1910. A pull-switch for turn-down lamps.

978,808. ELECTRIC CIRCULATION WATER HEATER. James I. Ayer, Cambridge, Mass., assignor to Simplex Electric Heating Company, Boston, Mass. Filed July 7, 1908. Includes means for giving the water a sluggish circulation through the heating coil.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired December 19, 1910:

510,889. TEMPERATURE REGULATOR FOR ELECTRIC HEATERS. Albert M. Butz, Oak Park, Ill.

510,898. ELECTRICAL CONNECTOR. Frank G. Curtis, New York, N. Y.

510,899. METHOD OF ADJUSTING THE JOINTS OF CARBON ELECTRODES. Elisha B. Cutten, New York, N. Y.

510,900. APPARATUS FOR ELECTROLYTICALLY PRODUCING SODA AND CHLORINE. Elisha B. Cutten, New York, N. Y.

510,901 and 510,902. ELECTRODE FOR VOLTAIC CELLS. Elisha B. Cutten, New York, N. Y.

510,921. ELECTRIC PUMP. Frank W. Merritt, Duluth, Minn.

510,929. SYSTEM OF TELEGRAPHY. Josiah A. Parker, St. Louis, Mo., and Leland L. Summers, Chicago, Ill.

510,932. ELECTRIC ELEVATOR. Frank A. Perret, Brooklyn, N. Y.

510,947. ELECTRIC LOCOMOTIVE. Charles F. Winkler, Troy, N. Y.

510,952. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES. Frank E. Averill, Syracuse, N. Y.

511,005. TELEGRAPHIC RELAY. Edward Weston, Newark, N. J.

511,017. ELECTRIC-RAILWAY SWITCH AND CROSSING. William W. Hendrix, Bowling Green, Ky.

511,018 and 511,019. ELECTRIC-RAILWAY TROLLEY. William W. Hendrix, Bowling Green, Ky.

511,049. ELECTRIC-ARC LAMP. August Hornell and George S. Junginger, New York, N. Y.

511,081. TELAUTOGRAPH. Rudolph M. Hunter, Philadelphia, Pa.

511,118. MAGNETO TELEPHONE. James A. Brown, Moline, Ill.

511,131 ELECTRIC-RAILWAY SIGNAL. José Ortega y Espinosa, Mexico City, Mex.

511,157. HAND REGULATOR FOR ELECTRIC MOTORS. William D. Packard, Warren, Ohio.

511,159. PRIMARY ELECTRIC BATTERY. Edward Poppowitsch, Brooklyn, N. Y.

511,163. SIGNAL FOR CABLE RAILWAYS. Joseph Sachs, New York, N. Y.

511,172. TELEGRAPHIC TRANSMITTER. Mary E. Stinde, Red Bud, Ill., administratrix of Herman F. Stinde, deceased.

511,173. ELECTRICALLY-OPERATED RAILWAY SWITCH. Chas. A. Stone, Newton, and Edwin S. Webster, Boston, Mass.

511,187. ELECTRIC REGULATING SWITCH. Edward A. Barber, Watertown, N. Y.

511,188. ELECTRIC SIGNALING DEVICE FOR HOSE. George L. Barnard, Milwaukee, Wis.

511,196. ELECTRIC MOTOR. Oliver E. Conklin, Dayton, Ohio.

511,214. BRUSH HOLDER AND ELECTRIC MOTORS. James J. Robinson and Fred B. Perkins, Toledo, Ohio.

511,229. ELECTRIC LAMP. Albert Zobel, Munich, Germany.

511,244. TELEGRAPH RELAY. Frank P. Medina, San Francisco, Cal.

511,245. THERMO-ELECTRIC ELEMENT. Max Mestern, Turin, Italy.

511,254. CLOSED-CONDUIT ELECTRIC RAILWAY. William S. Smith, Berkeley, Cal.

511,259. RHEOSTAT. Franklin A. Weller, Boston, Mass.

511,276. TWO-STATION TELEPHONE CIRCUIT. Frank Pickernell, Newark, N. J.

511,286. RESISTANCE BOX. Adelbert O. Benecke, Newark, N. J.

511,240. ELECTRIC SWITCH. Jesse L. Hinds, Syracuse, N. Y.